

Balboa Islands Seawall Rehabilitation Project

Rehabilitation Options



City Council Study Session
July 14, 2015



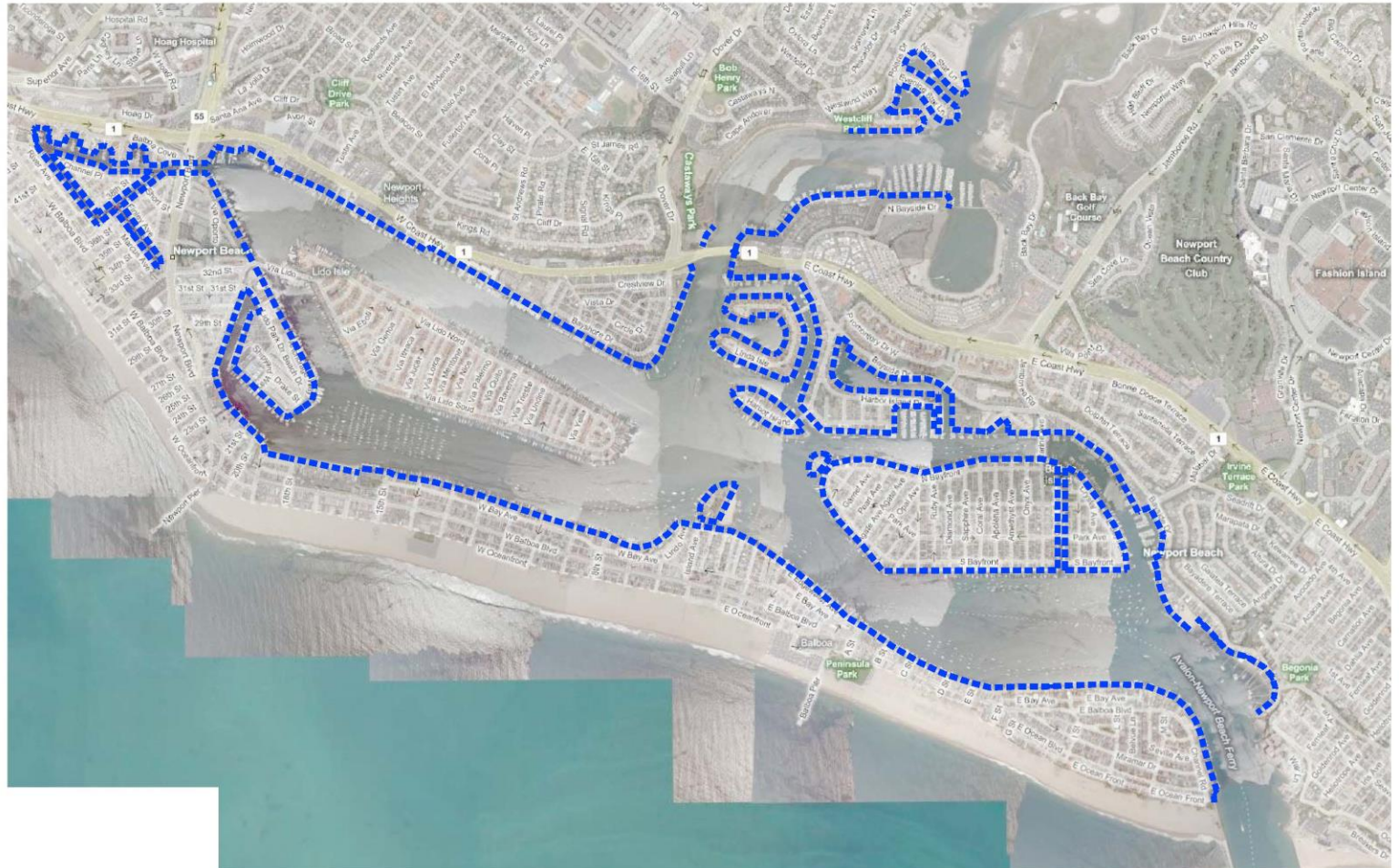
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 - Ferry Landing
 - Jetty Tide Gate
 - Storm Drain Collection System
 - ADA and Beach Access
 - Public and Private Pier Connections
 - FEMA Flood Plain

Background Information:

Public and Private Seawalls & Bulkheads

(~18 linear miles)



Background Information:

City-Owned Seawalls (~ 3 linear miles)

Balboa Islands account for about 2 miles.



Overview of Balboa Islands



0 50' 100' 150' 200'
GRAPHIC SCALE

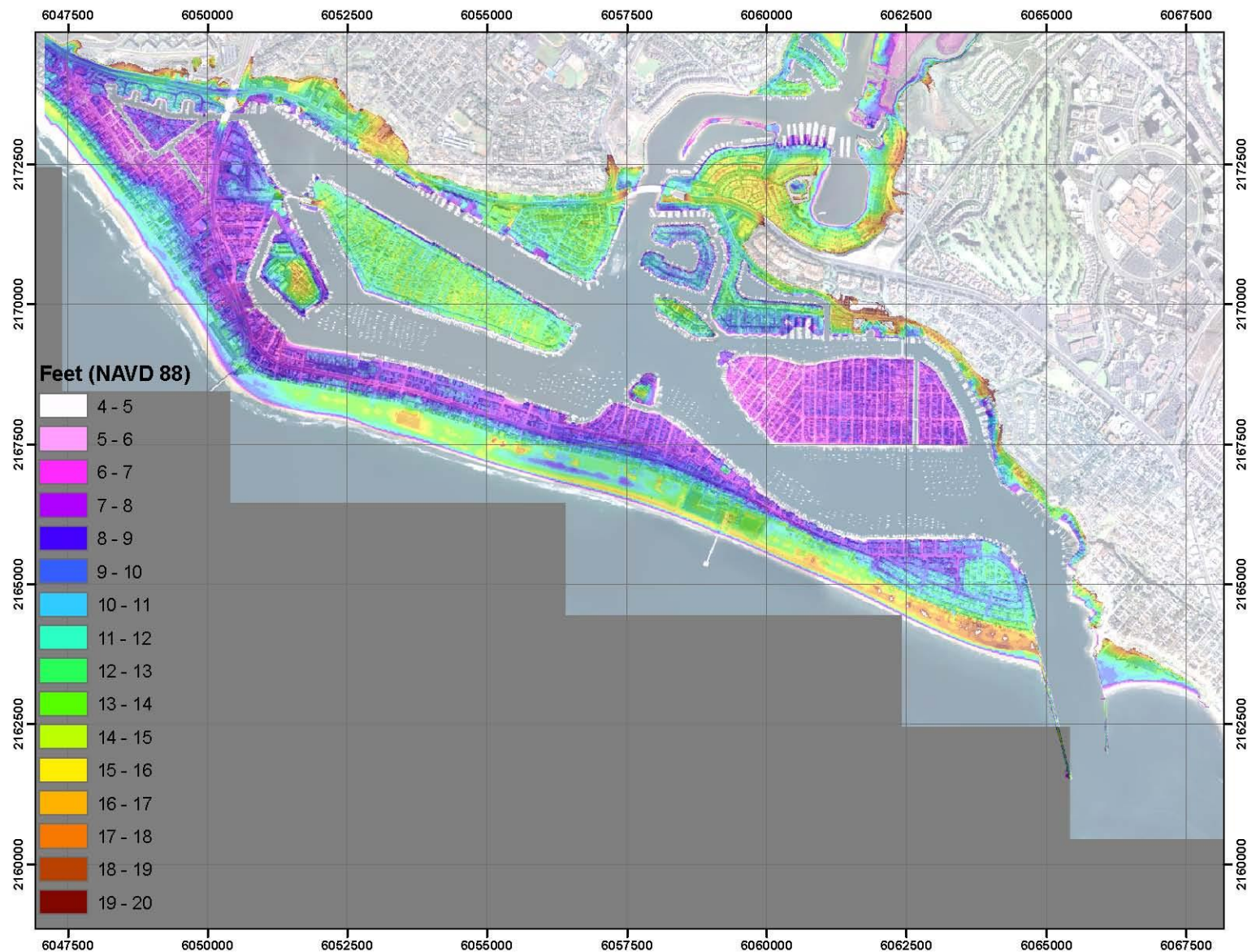
Background Information

- Balboa Islands are protected from flooding by **seawalls** that encircles both islands.
- Grand Canal Seawalls were built in 1929.
- West End Seawall were built in ~1925-1935.
- Remainder of seawall were built in ~1939
- The Balboa Islands are the lowest of the eight islands in the harbor: approximately Elevation 5'-7'. (Extreme high tides approach 8'.)

Reference Elevations

Location	Approximate Elevations
<u>Newport Harbor Island Land Elevations</u>	
Balboa Islands	5'-7' (NAVD88)
Lido Island	12'-13'
Harbor Island	10'-11'
Bay Island	10'-11'
Linda Island	9'-10'
Newport Island	10'
Collins Island	8'-9'
<u>Top of Wall Elevations at Other Locations</u>	
County of Orange (Dana Point):	9.62'
County of LA (Marina del Rey	9.62' - 11.62
City of Huntington Beach (General):	9.62'
City of Long Beach (Alamitos Bay):	9.62'
City of Long Beach (Naples Island):	9.50'
Balboa Island:	7.7' - 8.7'
Little Island:	8.5' - 9.3'

Low-Lying Areas Around the Harbor



Background Information

Existing Wall Condition

1. Existing walls are between 76 to 86 years old.
2. Original design lifespan was probably about 75 years.
3. Walls are exhibiting obvious signs of deterioration and stress.
4. Existing walls subject to **Seismic Risk**.
5. Grand Canal: Depth of wall below mudline is very shallow.
6. Many unknowns on the condition of the:
(a) seawall steel reinforcement, (b) soldier piles,
(c) walls below the mudline, and (d) seawall tiebacks.
7. Useful remaining lifetime? Per a City seawall assessment report (2011) - **perhaps as little as 10 years**; maybe as much as 25 years.

Background Information

Existing Wall Condition

There have been a string of repair/maintenance projects over past 40 years:

- Grand Canal Seawall Coping Repair/Sealing ('76, '78, '79, '80)
- West End/Grand Canal Spot Sidewalk Grouting/Compaction ('80)
- Grand Canal Seawall Plaster Sealing ('81)
- Grand Canal Seawall and Sidewalk Joint/Void Grouting ('83)
- New Tie Rod Installation/Deadman Spot Repair E/o Agate ('87)
- West End Wall Stabilization: Rock Armor at Toe, Earth Anchors, Void Grouting ('87)
- Island Wide Spot Seawall Repair and Joint/Crack Sealing (2003-2007, 2009-present)

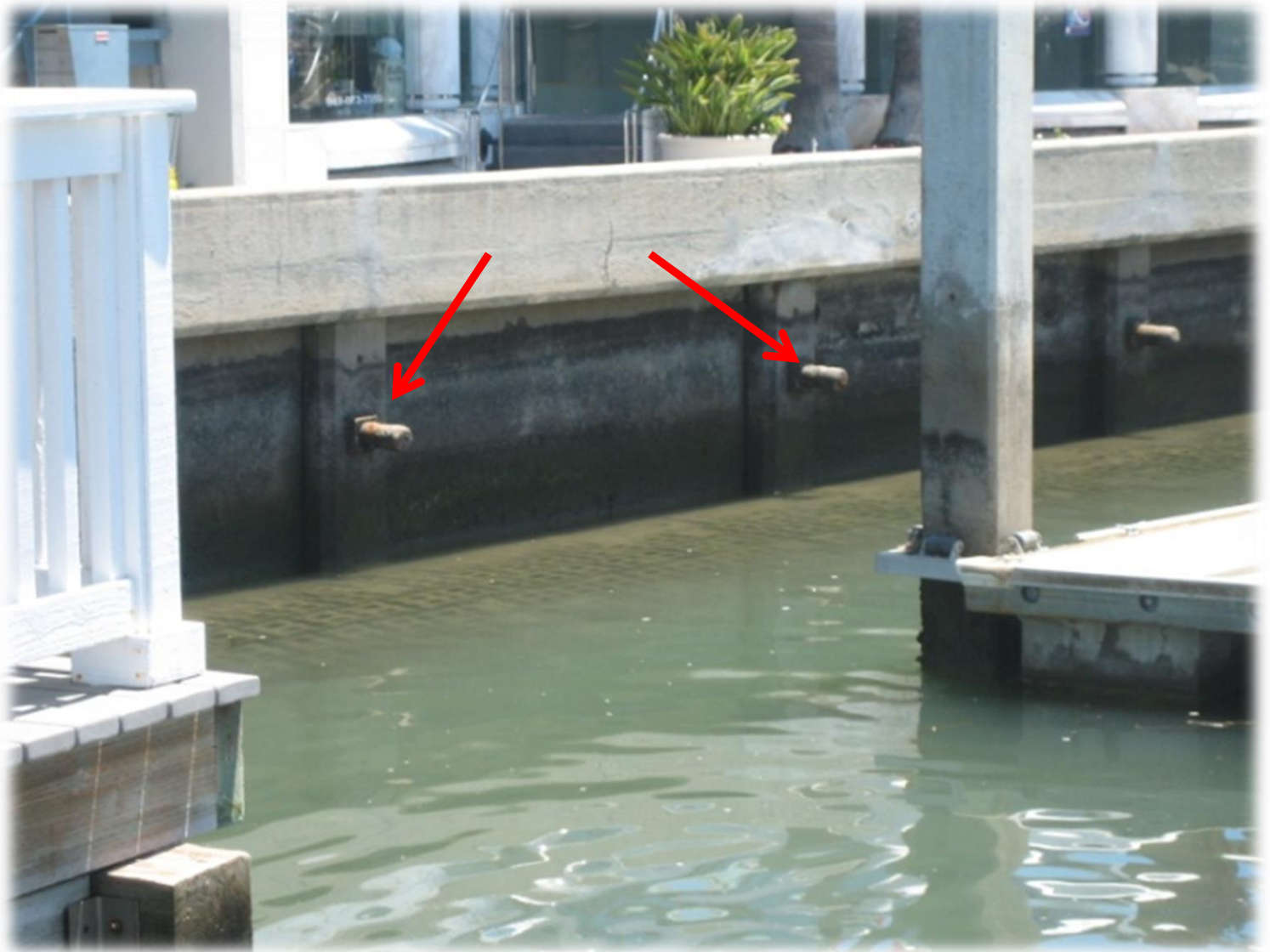


Rock Ballast Placed at
West End for Support
(1985)

Rock Ballast Replaced
at Corners of Grand
Canal and Little Island
for Support (~2000)



Earth Anchors installed E/o Balboa Island Ferry Landing - South Bay Front (1987)



Pile Cracks (West End)



Wall Movement
(West End)

Grand Canal: Spalling Veneer



Grand Canal: Spalled Veneer



Grand Canal: Spalled Veneer on Soldier Pile



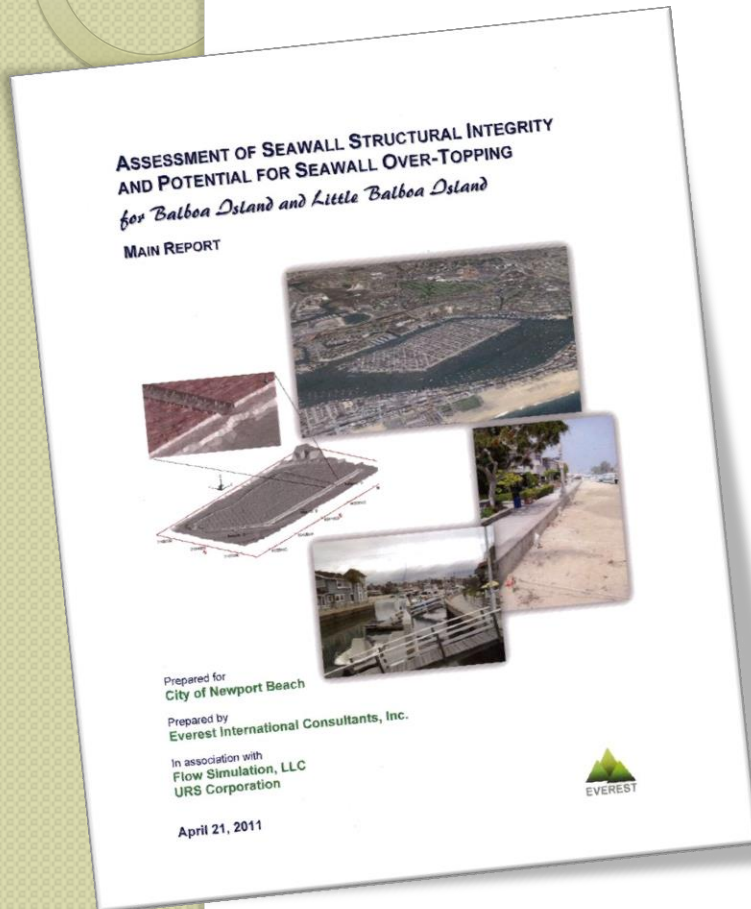
Grand Canal: Cap Veneer Spalled



Balboa Islands – Seawall Structural Integrity and Over-Topping Assessment Study Completed April 2011

Seawall Condition

- Seawall Age: 76-86 years
- Overall Condition: Holding together fairly well with widespread surficial cracks with some concrete spalling and evidence of corroding rebar.
- Estimated Useful Life: Perhaps as little as 10 years, maybe as long as 25 years. (2011 report)



Two Primary Issues to Address

- 1) Maintaining the Structural Integrity of the Seawalls.
 - New Seawall and/or Seawall Rehabilitation

- 2) Addressing the Current Water Over-Topping of the Walls and Planning for Future Sea Level Rise.
 - Top of Wall Elevation

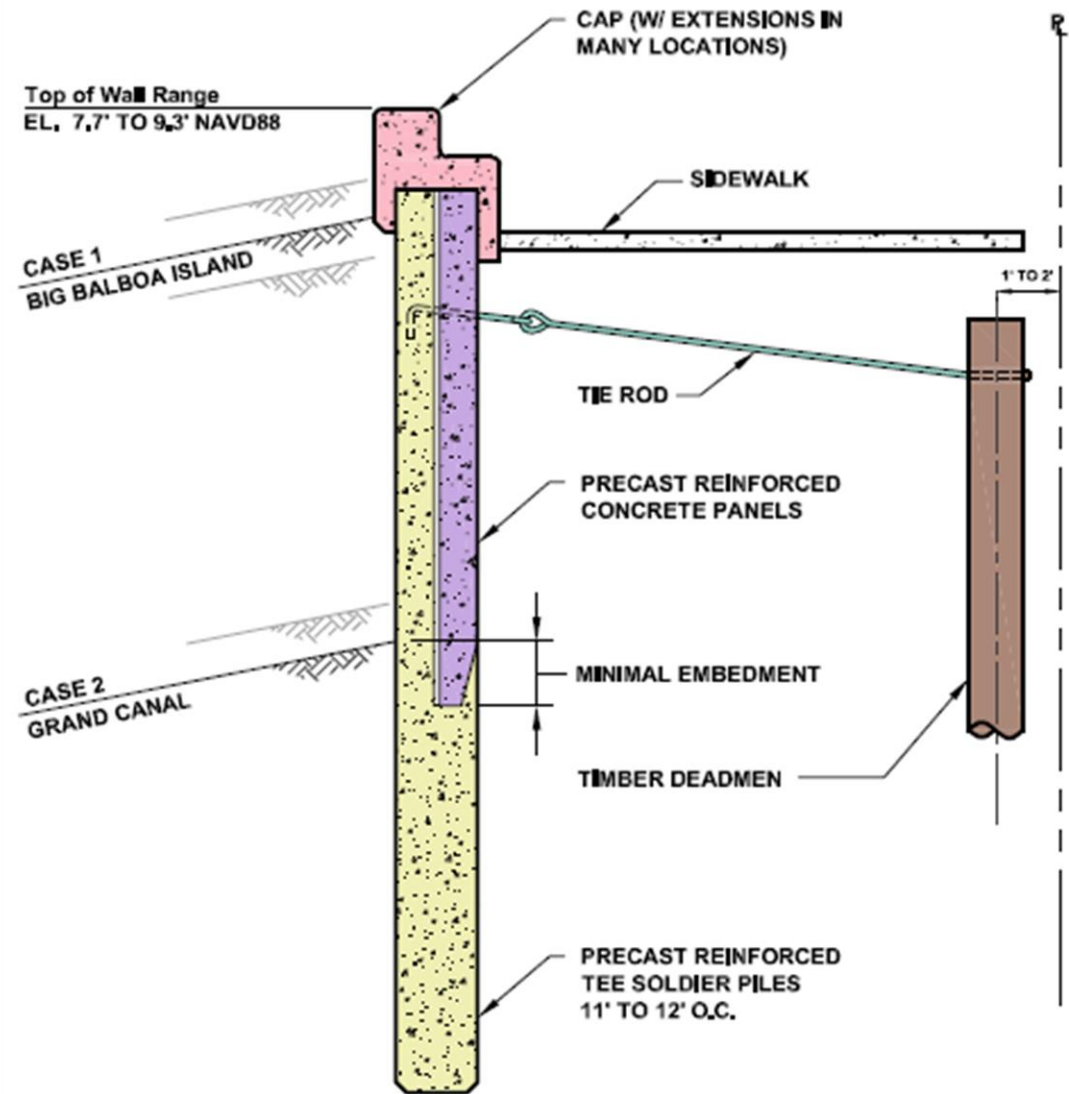


Issue 1: Maintaining the Structural Integrity of the Seawall

When weighing the advantages of alternative construction options: **new seawalls** or **seawall rehabilitation**, some items to consider include:

- Condition of Existing Walls (*approaching 90 years old*)
- Expected Lifespan
- Cost - *including Maintenance*
- Seismic and Storm Endurance
- Liabilities and Exposure to a Failure

Grand Canal As-Built Condition



TYPICAL WALL CASES⁽¹⁾

⁽¹⁾ OTHER NON-TYPICAL CONDITIONS EXIST

Rock
reinforcement
installed 1985



New Seawall Construction – Option 1

H-Piles and Concrete Wall (Lag) Panels

(No tiebacks)



New Seawall Construction – Option 2

Steel Sheet Pile Bulkhead

(No tiebacks)



Bay Island: Steel Sheet Piles and Cap



09/15/2014

Bay Island Sheet Piles and Cap



Steel Sheet Piles Installation (Silent Pile Driver)

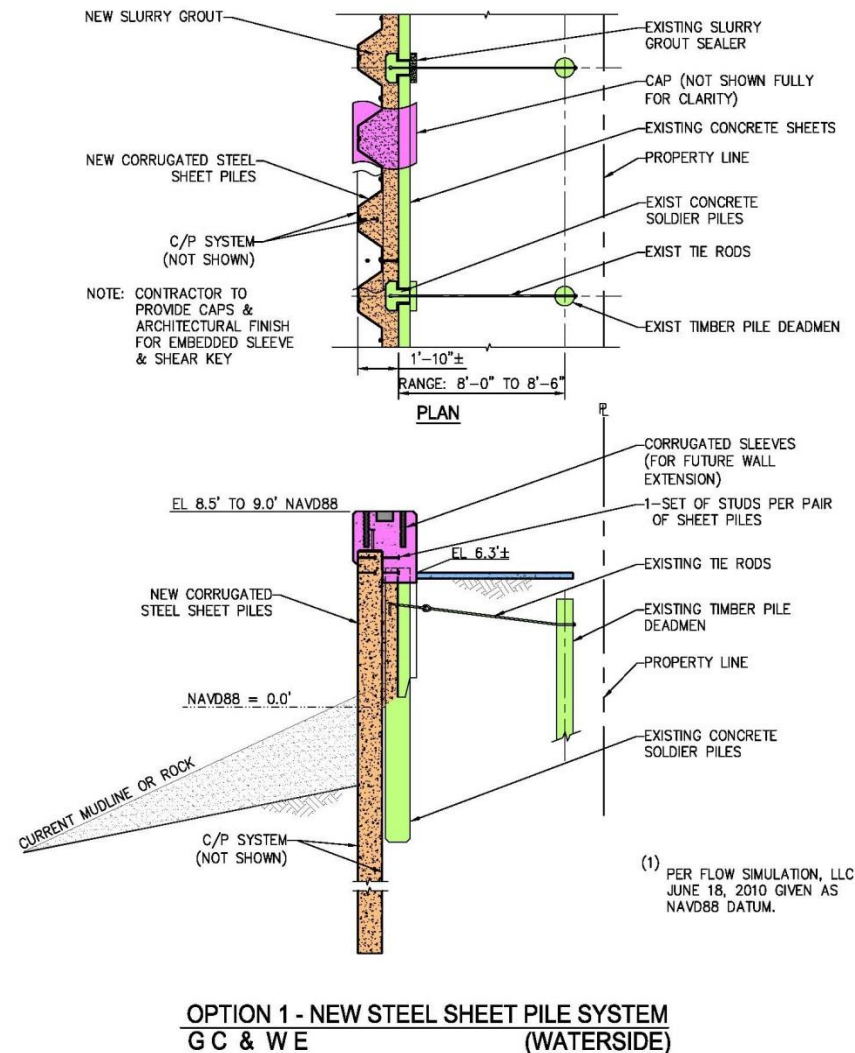


As for Seawall Replacement:

Staff & TMC recommend the steel sheet pile walls.

- Slightly Lower Construction Cost
- Much Less Disruption to Install

Seawall rehabilitation will be considered later in the presentation.



Issue 2: Addressing Current Water Over-Topping of the Seawalls and Planning for Future Sea Level Rise



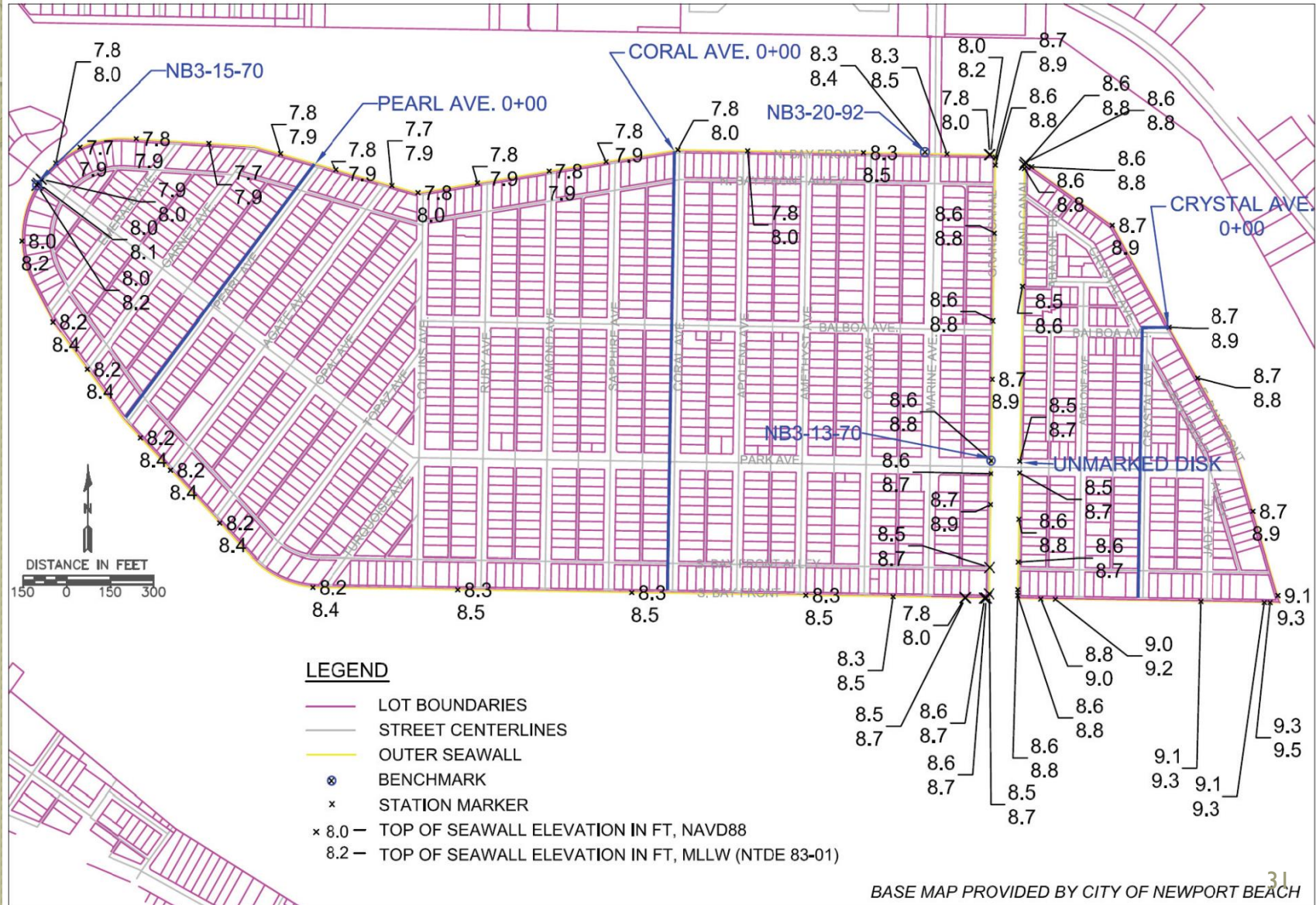
South Bay Front, 2005

New Top of Wall Elevation

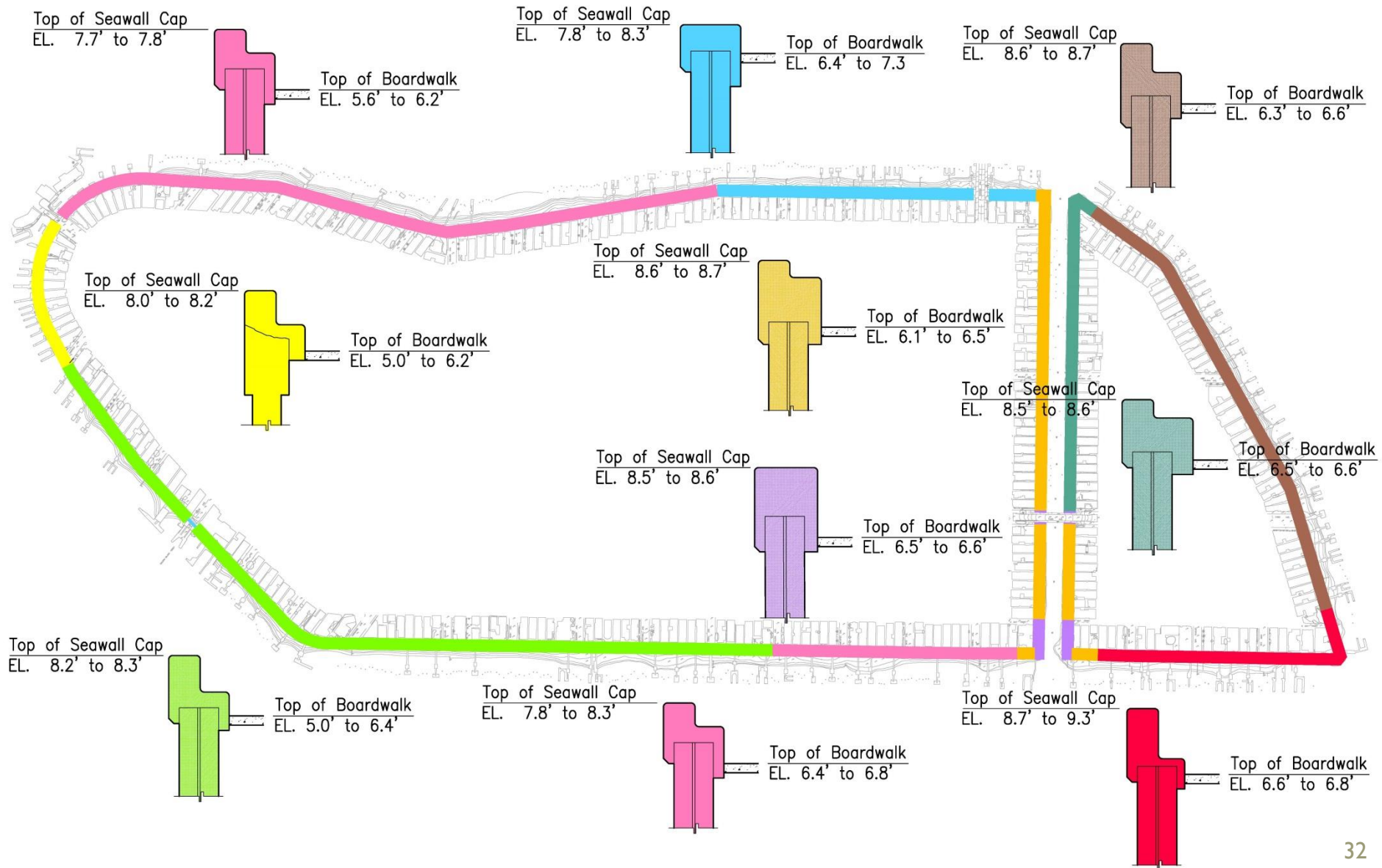
◦ *Items to consider for selecting a new top of wall elevation:*

- Potential of Flooding from:
 - ✓ High Tide Levels
 - ✓ Local Wind Waves
 - ✓ Storm Surge
 - ✓ Ocean Swell
- Cost of Alternatives
- Ability and Estimated Time Intervals to Raise Cap Elevation
- Ability to Store and Pump-Out Water
- Liability and Exposure to Flooding
- Maintaining Beach Access and Views

Existing Top of Wall Elevations



Wall Elevation Study – Various Existing Conditions



Substandard Freeboard

Southwest end of Balboa Island during a King Tide on December 12, 2013 with no storm surges or wind waves.

8.2' NAVD88



Overtopping Due To Storm Surge



South Bay Front

Overtopping Due To High Tides and Wind/Boat Waves (South Bay Front, 2010)



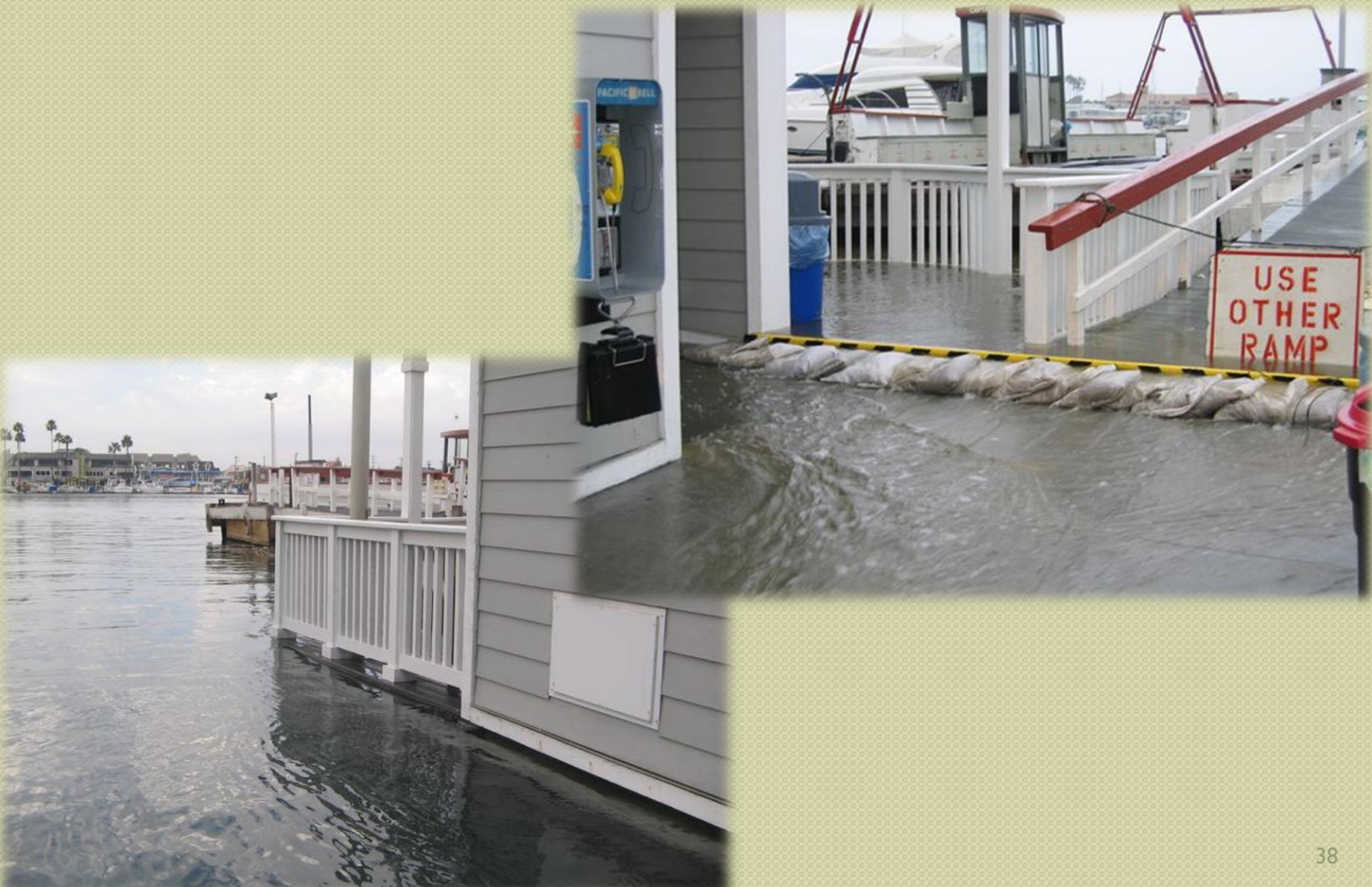
Hide Tide at north West End (2005)



Wind Waves at High Tide (West End)



Flooding at Balboa Island Ferry Landing (2005)



Flooding at Balboa Island Ferry Landing



MOD staff mobilize portable emergency pumps to bail accumulating rain and over-topping flows.



Street Flooding Overtopping Curb at Turquoise Avenue (December 22, 2010)



Islands' Flood Potential

It is a State requirement that our Coastal Projects consider potential sea level rise. The California Coastal Commission sea level rise guidance document recommends planning for as much as a **66-inch rise by 2100.**

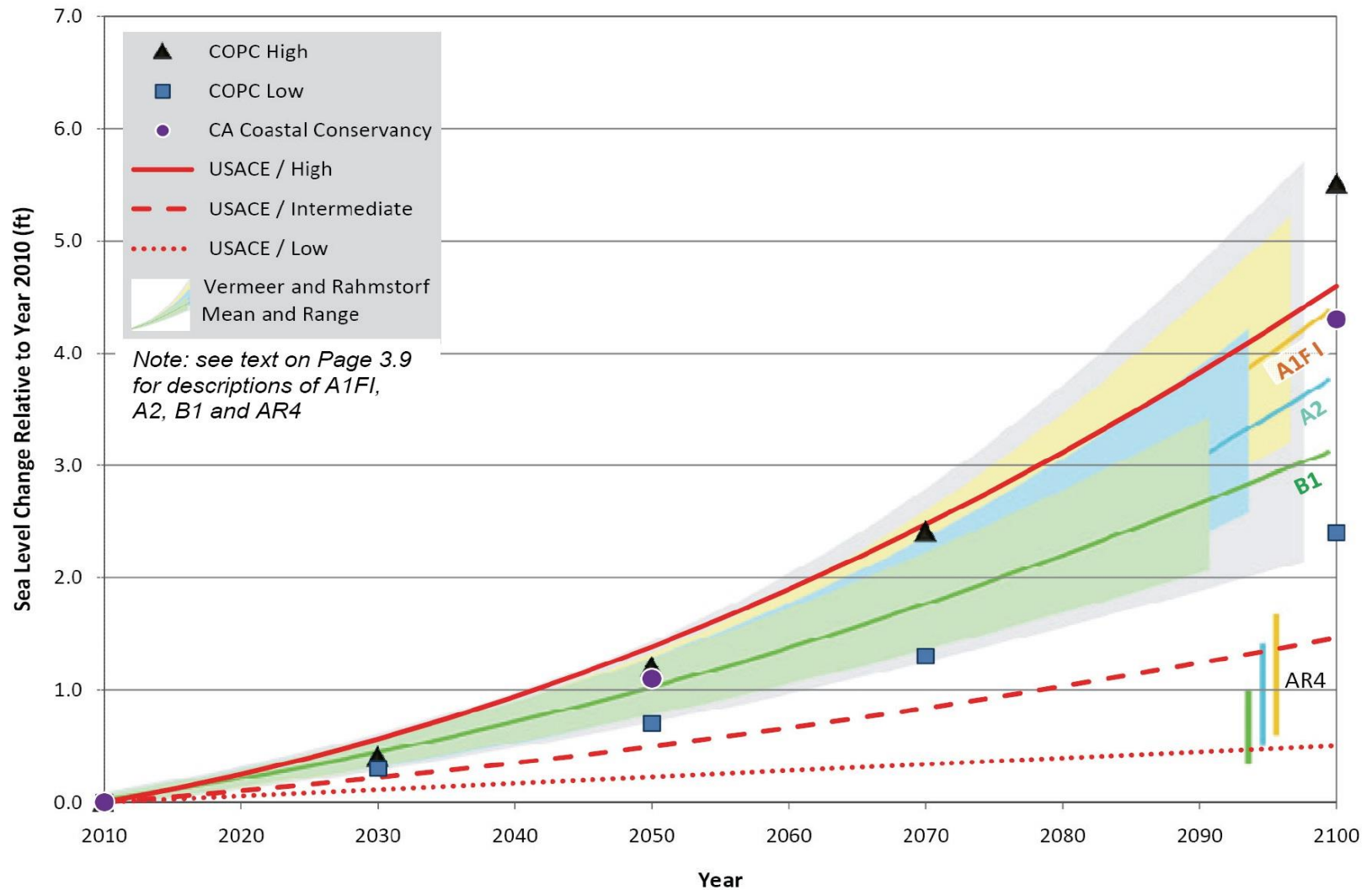


Sea Level Rise Predictions – 2100

The “95%” column on the right side indicates that there is a 5% chance the predicted sea level rise will be exceeded.

Agency	Year	5%	50%	95% (high confidence)
IPCC 4 th Assessment	2007	9”	15”	20”
Vermeer and Rahmstorf	2009	39”	49”	61”
US Corps of Engineers	2011	17”	39”	59”
National Academy of Sciences	2012	17”	37”	66”
IPCC 5 th Assessment	2013	17”	24”	31”
Quaternary Science Reviews	2014	28”	37”	47”

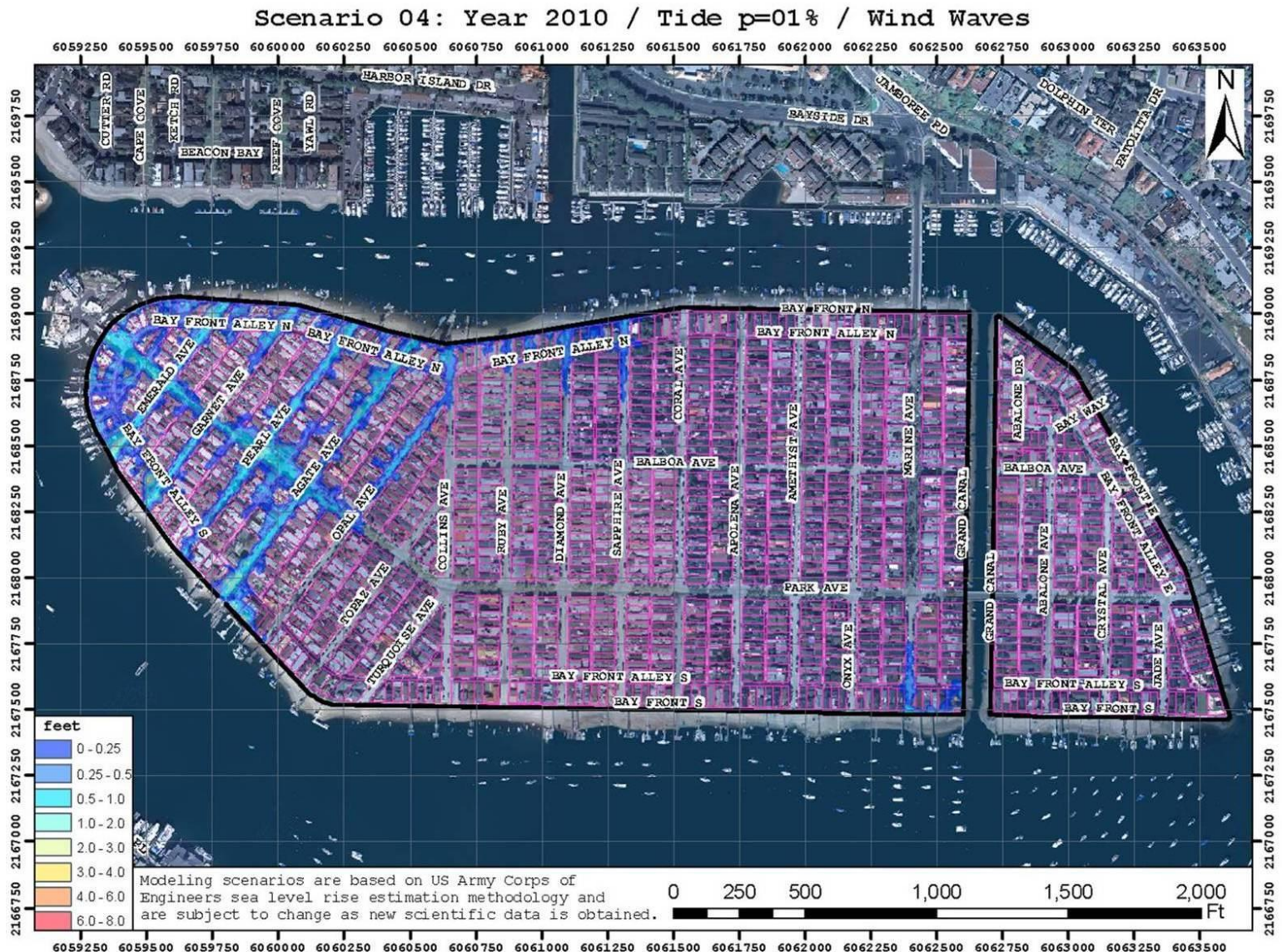
Sea Level Rise Projections



Projected Sea Level Rise – 2100

- Mean sea level rise is expected to be in the range of 24-36 inches.
- California State Coastal Conservancy (SCC) in 2009 adopts a Climate Change Policy that agencies should prepare for a 55-inch sea level rise by 2100. (high confidence)
- California Coastal Commission (2015) recommends planning for a 66-inch sea level rise by 2100.

Current Wall Heights - Flooding Potential: 2010 - Highest 1% (7) Tides with Wind Waves



Current Wall Heights - Flooding Potential: 2010 Highest 10% (70) Tides Ocean Swell

Scenario 03: Year 2010 / Tide p=10% / Ocean Swell



December 2010 Flooding on Turquoise Avenue: High Tide (p=40%) with Ocean Swell



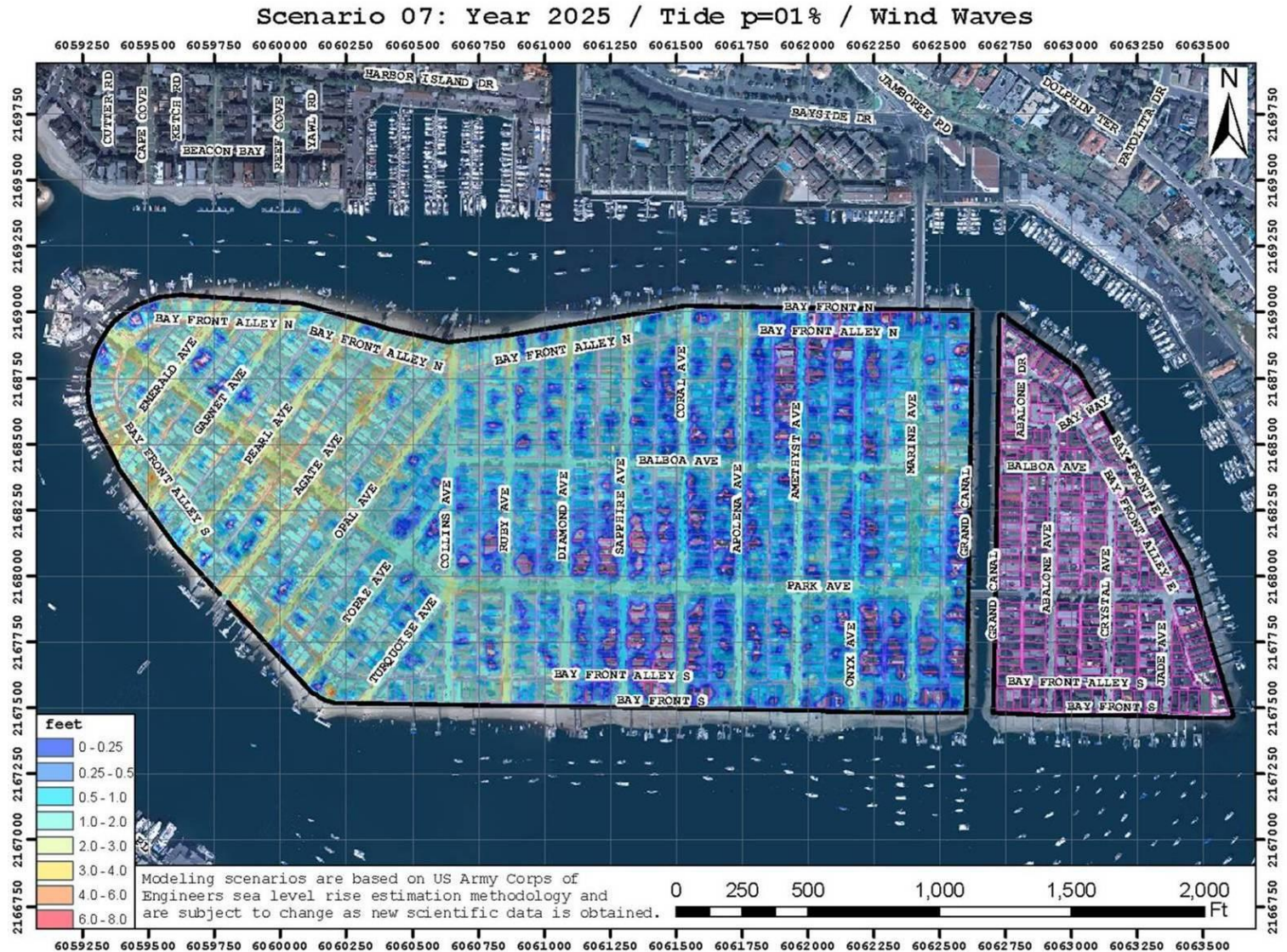
The Real Threat with a Flood is the Water Just Needs to Rise for an Instant and the Damage is Done



Flooding Event, Balboa Avenue at Marina Avenue Looking East

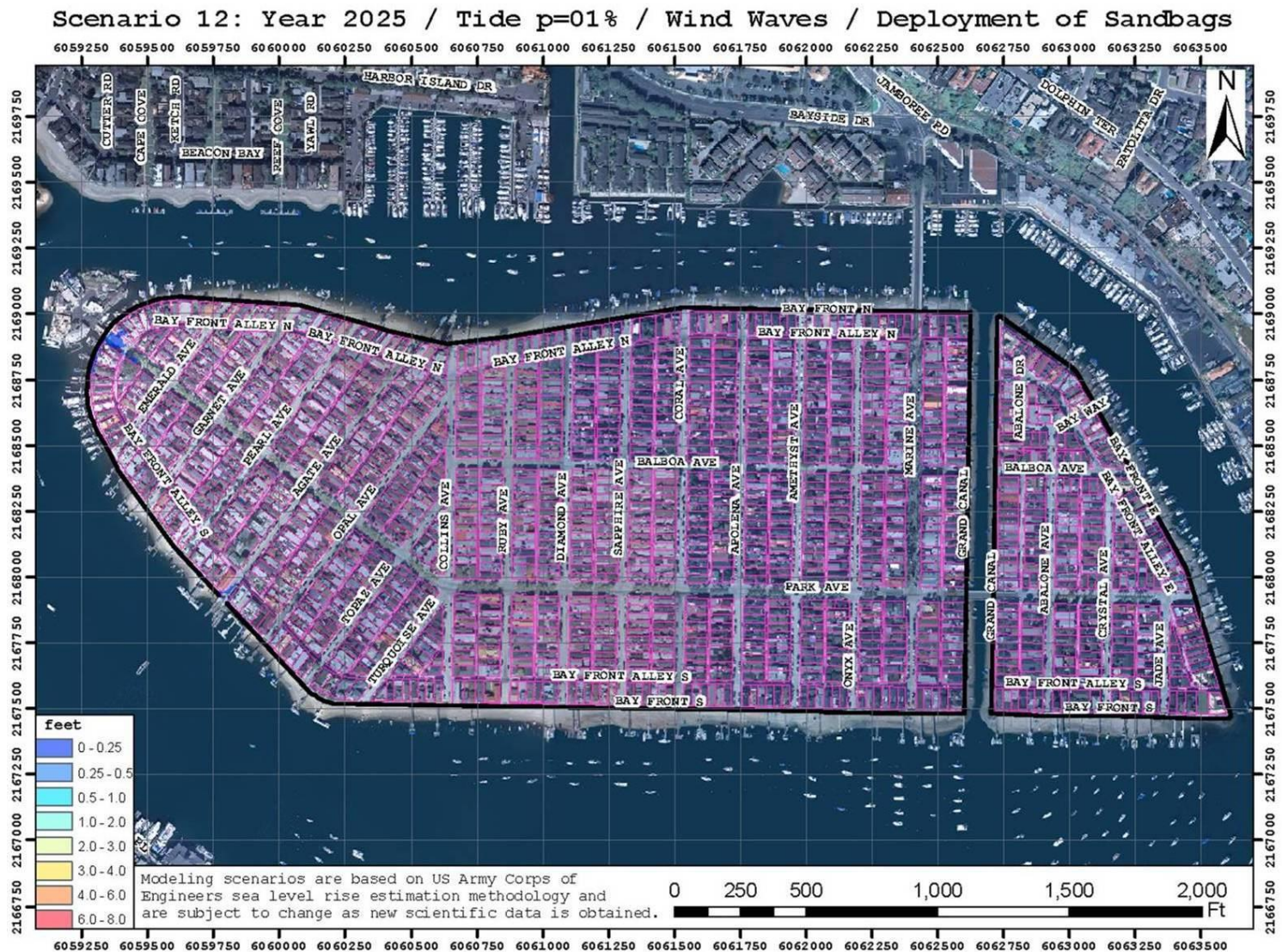
Current Wall Heights - Flooding Potential:

2025 - Highest 1% Tides with Wind Waves



Estimated Flooding Potential:

2025: Almost no flooding with 6" high sandbags.





Tidelands Management Committee Review (2011-2015)

- Many open public meetings with robust presentations and productive discussions.
- Discussions included review and guidance by URS Corporation consultant staff (Professional Marine Engineers).
- Active participation by Balboa Island Improvement Association and many Islands residents.

Tidelands Management Committee Review

Tidelands Committee members comments and direction lead to exploring several options for providing seawall structural stability and current/future flood protection including:

- Considering replacing all islands' seawalls with an initial top elevation of 10' now with ability to extend cap height up to 14' as needed in the future.
- Exploring the option of a major Tidal Gate structure option at Harbor Entrance.
- Suggesting several options of phased construction consisting of various degrees of seawall replacement or rehabilitation with incremental raising of the new and existing cap elevations to adjust as needed to rising sea levels.

Tidelands Committee Guiding Direction

- Would like to get as much useful life/benefit out of existing seawalls.
- To minimize up front replacement cost, look at structural wall rehabilitation or other methods of support, and raising cap elevation on existing walls where it makes sense.
- Because there is a good deal of uncertainty associated with future sea level rise projections, raising wall height elevation should be kept as low as reasonable now to minimize impacts on beach access, related infrastructure cost (wall replacement, adjacent boardwalk, drainage system) and public and private views.
- Design all new walls to accommodate future extension of the cap elevation.

Two Primary Issues to Address

- 1) Maintaining the Structural Integrity of the Seawalls.
 - New Seawall and/or Seawall Rehabilitation
- 2) Addressing the Current Water Over-Topping of the Walls and Planning for Future Sea Level Rise.
 - Top of Wall Elevation



Issue 1. Maintaining the Structural Integrity of the Seawalls: Summary of Advantages

- New seawalls are structurally sound and protective of seismic failure. Maintenance requirements are small. No easements required.
- Seawall rehabilitation reduces initial costs.



Issue 2. Addressing Current Water Overtopping of the Seawalls and Planning for Future Sea Level Rise - Summary of Concerns:

1. Seawall overtopping is occurring now. City crews must mobilize portable pumps to bail water out.
2. By 2025, a major storm could cause widespread flooding beyond the capability of City crews to provide emergency relief. Cars and low lying structures would could be flooded.



Initial minimum top of wall elevation to provide normal over-topping flood protection until ~2025.

LOCATION	Current	New	Difference
• Balboa Island N.	7.8'	8.5'	+8.4 inches
• Balboa Island S.	8.25'	9.0'	+9 inches
• Grand Canal	8.5'	8.5'	
• Little Island E.	8.7'	8.7'	
• Little Island S.	9.0'	9.0'	

** all elevations based on NAVD88 datum.*

Important Note: These are minimum initial top-of-wall elevations to address conservative, high confidence projections of expected tides and wind waves. They do not take into account possible extreme conditions or Acts of God.



Seawall Replacement Options Considered

– Immediate Costs

- | | | | |
|----|--|--------------|------------|
| A. | 10,352' new seawalls.
2,808' cap extensions. | \$68 million | Long Term |
| B. | Rebuild most vulnerable
seawalls (4,420 ft.). Cap
extensions for remainder. | \$35 million | Best Value |
| C. | Rebuild 640 ft. of seawall.
Retrofit most vulnerable
seawall. Cap extensions
for the remainder. | \$17 million | Short Term |
| D. | Retrofit most vulnerable.
Cap extensions for the
remainder. | \$14 million | Short Term |

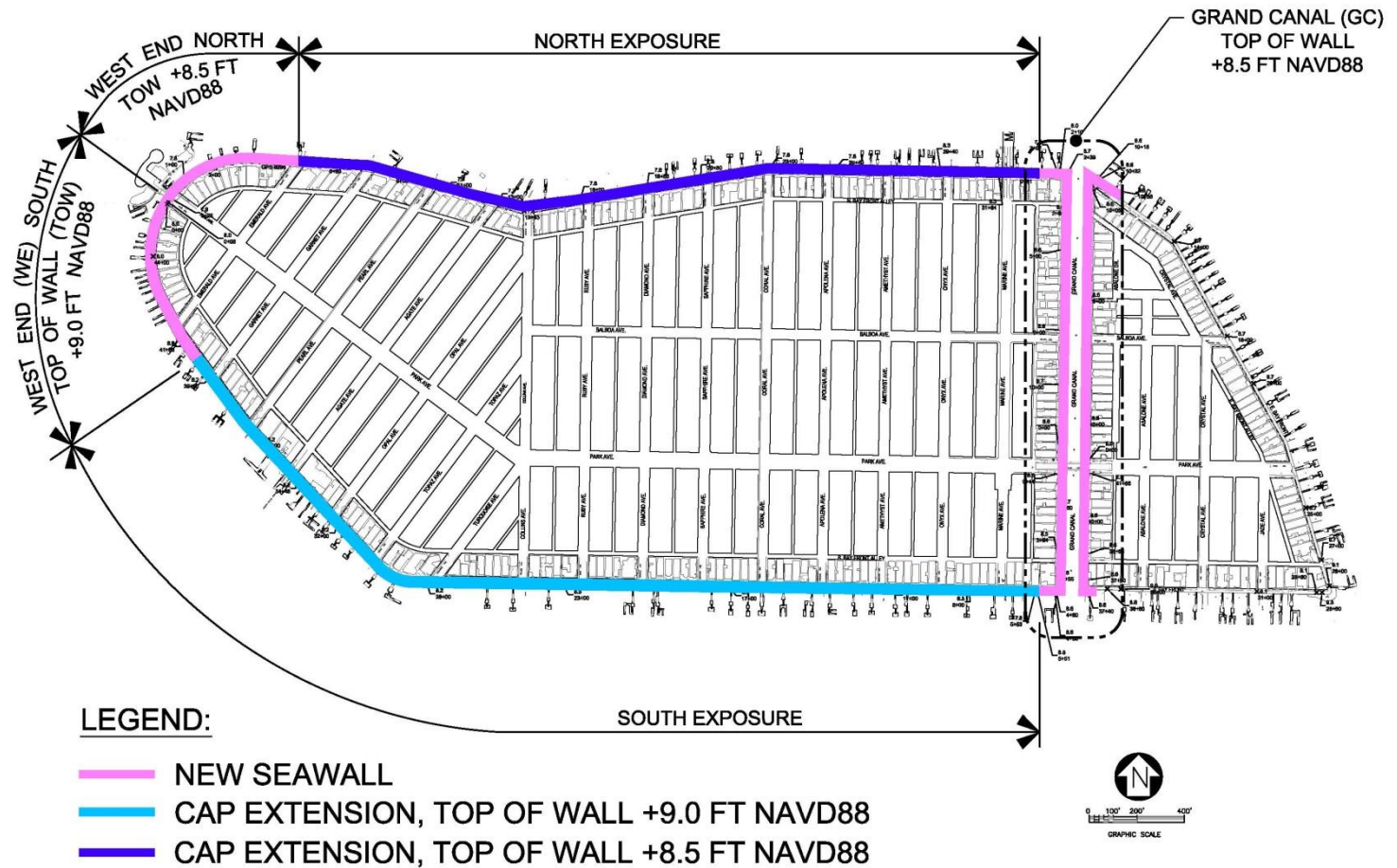
Option A: 10,352' of new seawalls. 2,808' cap extensions.

Estimated cost	\$54 million
25% contingency	<u>14 million</u>
Total	\$68 million

Notes:

1. Costs includes seawalls, caps, pier and beach access ramps, modifications to the entrance to the Ferry Landing and Collins Islands, and ADA modifications to the Boardwalk near the Mariner's Bridge. Cantilevered walls will be designed to be allow for cap extensions to Elevation 14' if needed.
2. Seawall cost are based on 2014 bids for the new seawalls in Naples, Long Beach.
3. Additional cost to extend cap 6 inches in 2025 to Elevation 9.5'/9.0' (including Little Balboa Island): ~ \$3 million.
4. Additional cost to replace 2,808' capped seawalls in 2040. with new seawalls and boardwalk: ~\$17 million (25% contingency).
4. Costs in today's dollars.
5. Elevation Datum: NAVD88

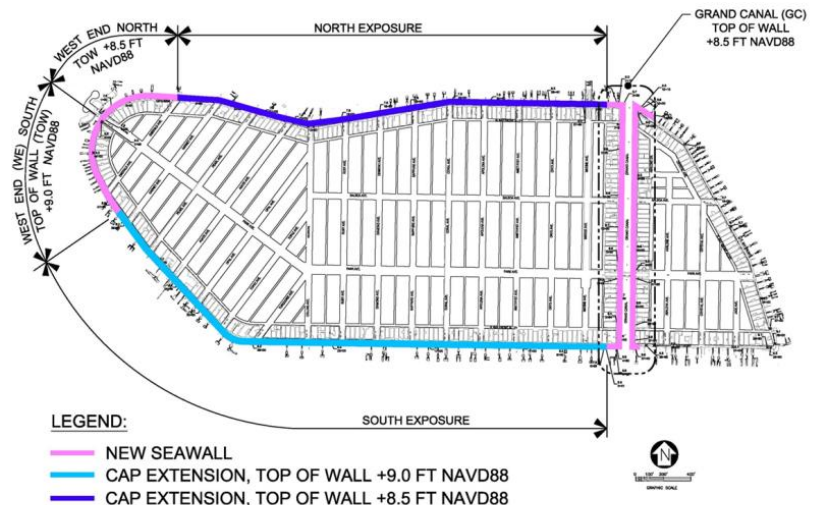
Option B: New Seawalls at West End and Grand Canal (4,420'). Cap Extensions on Remaining Walls (8,740') .



Option B: Summary of Improvements

- a. New seawalls along entire length of West End (1,170'):
South side - Elev. 9.0' and North Side - Elev. 8.5'.
- a. New seawalls on both side of the Grand Canal (3,250')
(Elevation 8.5').
- a. Raise seawall cap on South side of Balboa Island to
Elevation 9.0' (3,420').
- b. Raise seawall cap on North side of Balboa Island to
Elevation 8.5' (2,750').

(Elevation Datum: NAVD88)



Option B: Seawall Cap Extension Example on Little Balboa Island



Option B: 4,420 Feet of New Seawalls plus Cap Extensions.

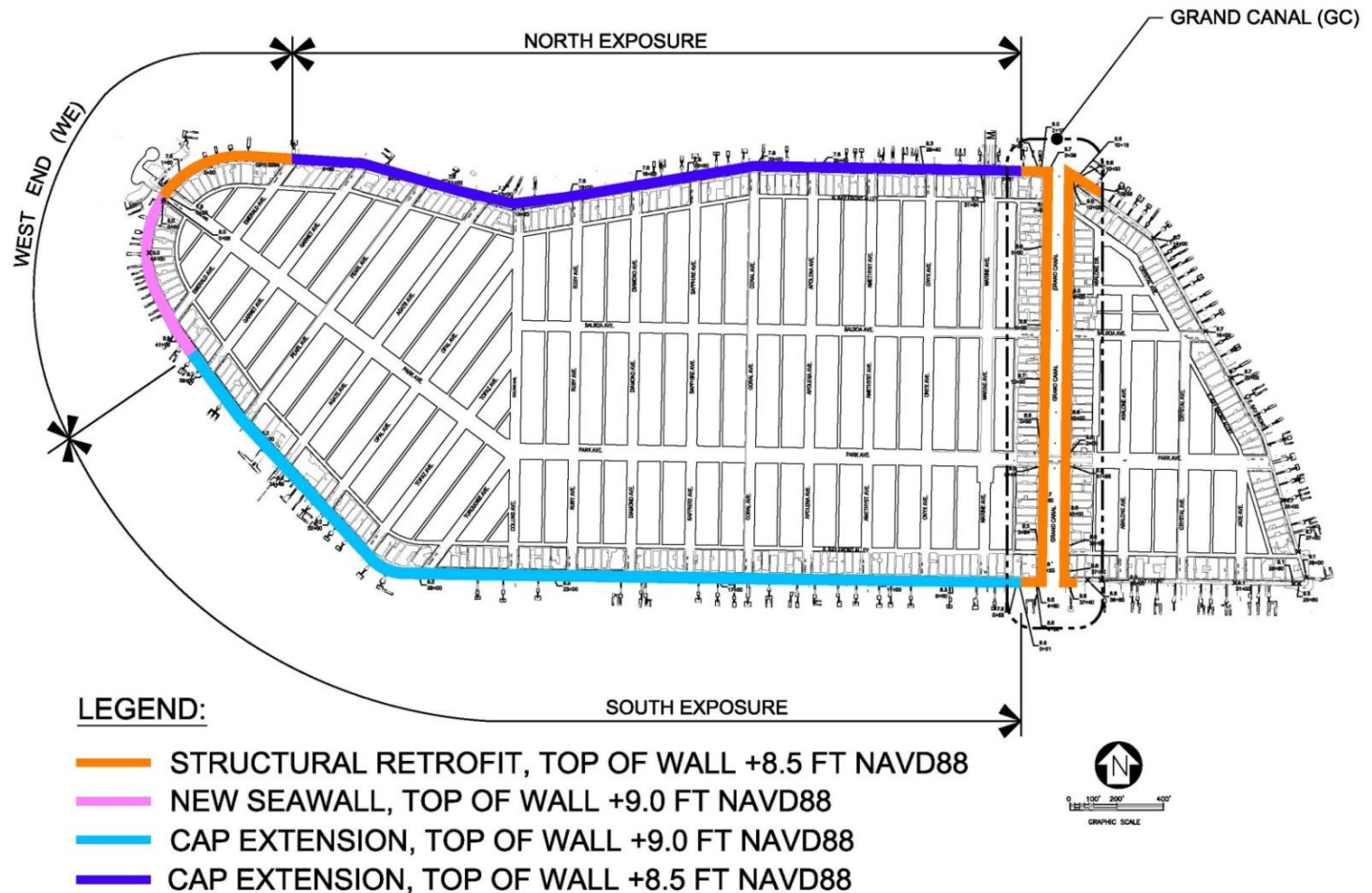
Initial cost	\$28 million
25% contingency	<u>7 million</u>
Project total	\$35 million

Notes:

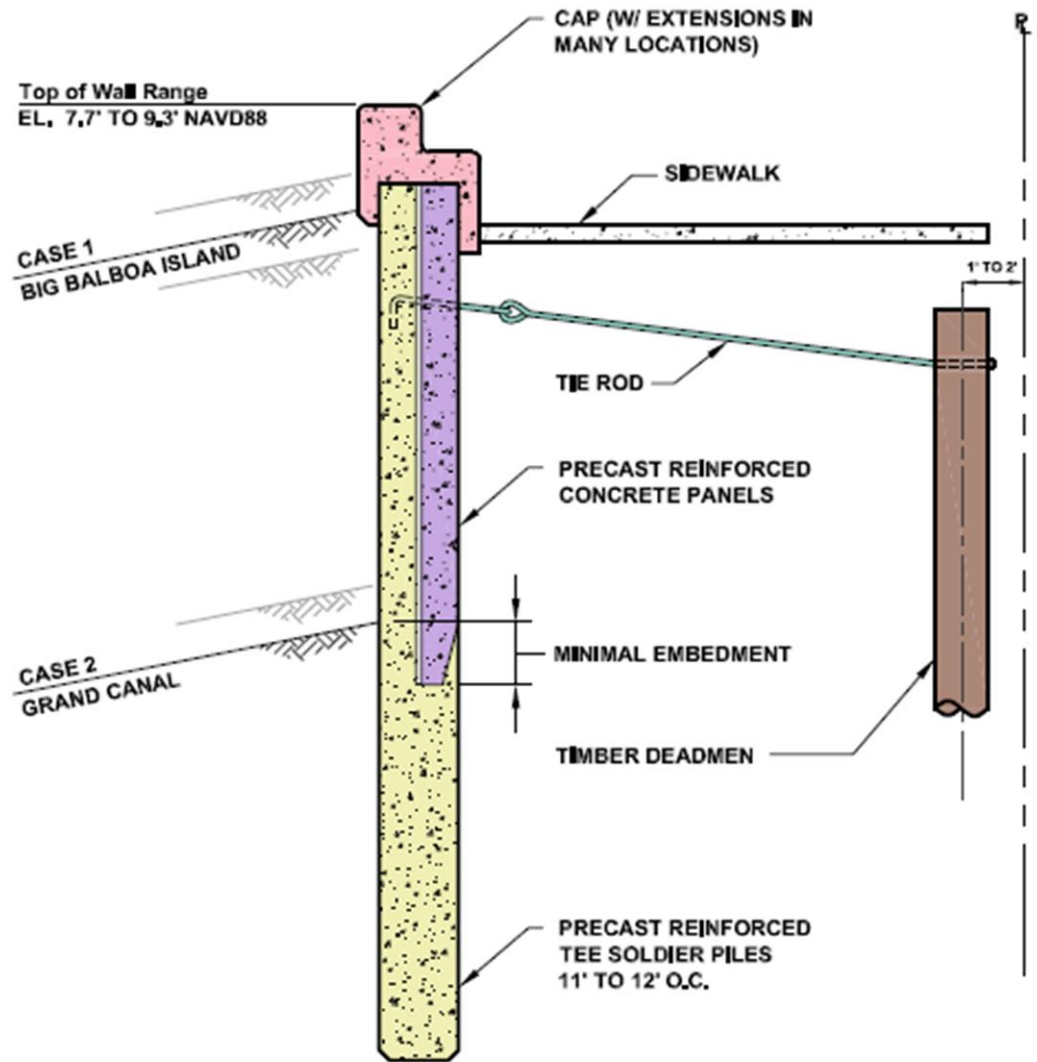
1. Costs includes seawalls, caps, temporary pier and beach access ramps, modifications to the entrance to the Ferry Landing and Collins Islands, and ADA modifications to the Boardwalk near the Mariner's Bridge. **Cantilevered walls will be designed to be allow for cap extensions to Elevation 14' if needed.**
2. Seawall cost are based on 2014 bids for the new seawalls in Naples, Long Beach.
3. Additional cost to extend cap 6 inches in 2025
(including Little Balboa Island) to 9.0'/9.5': ~ **\$3 million**
4. Additional cost to replace 8,740' of capped seawalls in 2040
with new seawalls and boardwalk: ~**\$52 million** (25% contingency)
5. Costs in today's dollars.
6. Elevation Datum: NAVD88

Option C:

- 1) 640' New Seawall at Southwest End of Balboa Island.
- 2) Seawall Rehabilitation or Cap Extension of Remainder.



Grand Canal As-Built Condition



TYPICAL WALL CASES⁽¹⁾

⁽¹⁾ OTHER NON-TYPICAL
CONDITIONS EXIST

Newport Marina Villas Townhomes ~1995

Seawall Failure – Shallow Pile Embedment



Grand Canal: Cap Veneer Spalled



Option C: Structural Considerations for Seawall Rehabilitation

80 to 86 year-old walls. (Original lifespan approximately 75 years.)

1. Grand Canal Walls:

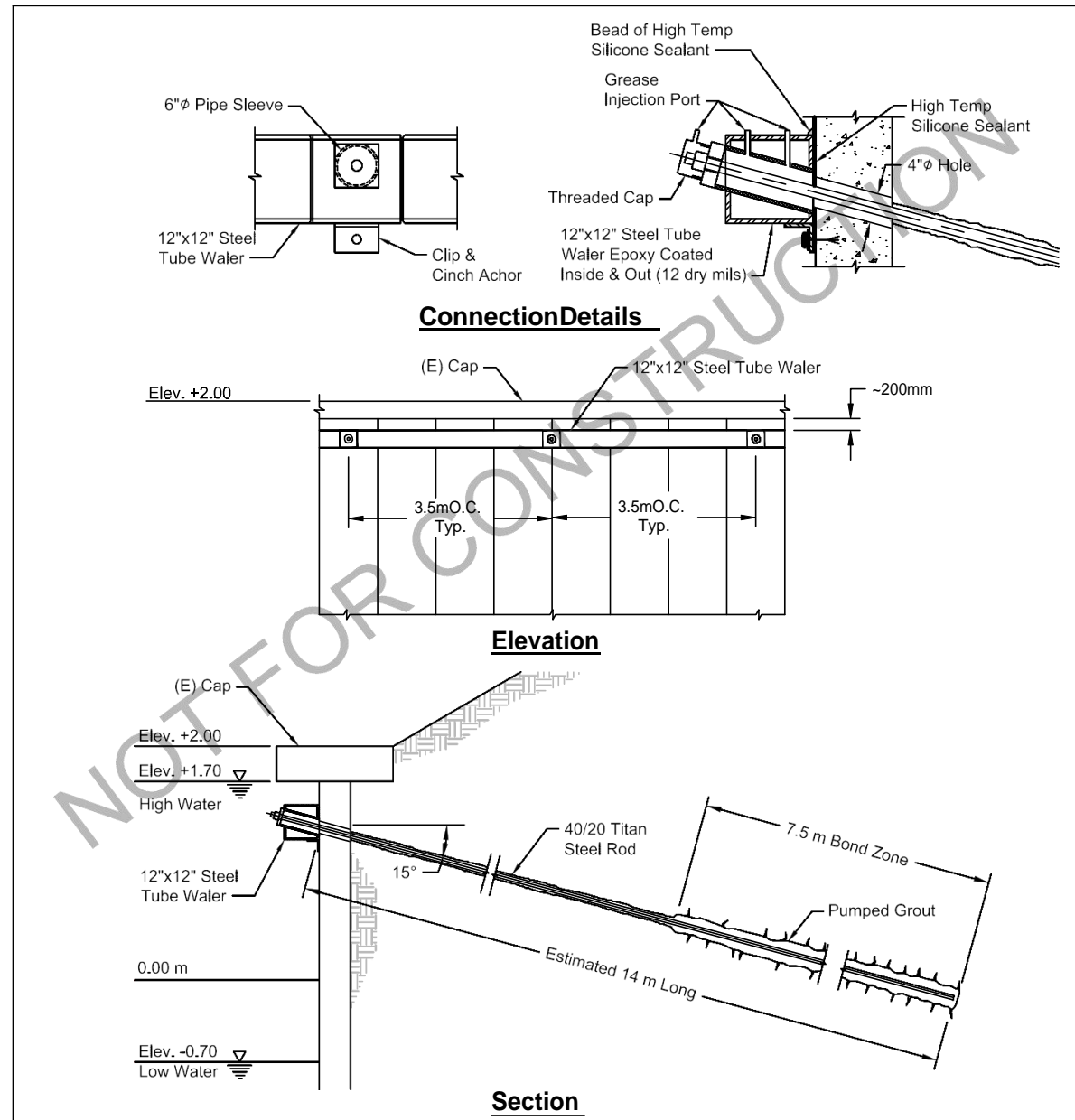
- a. Wall veneer is failing.
- b. Very shallow embedment of soldier piles and concrete planks (~2 to 3 feet).
- c. Corroded tie rods.

2. West End:

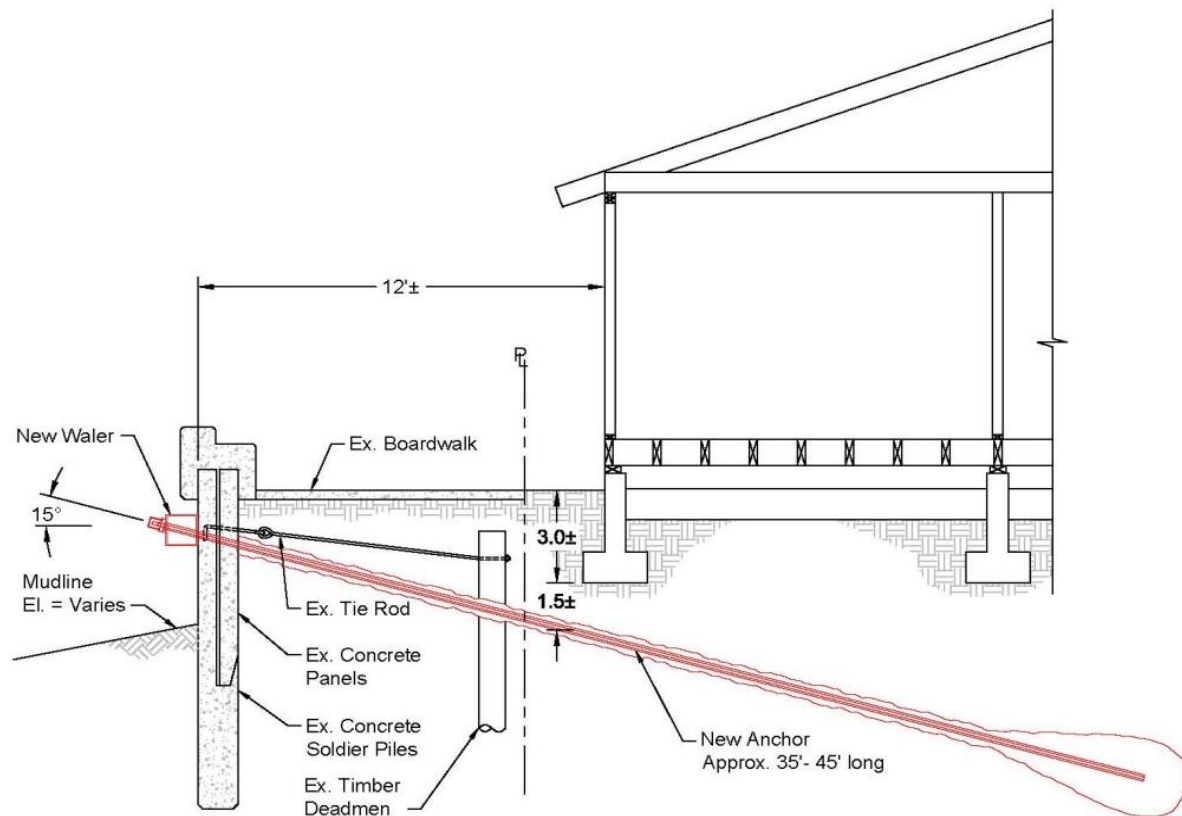
- a. Floating sidewalks at high tide indicating leaks in the wall.
- b. Surficial signs of distress caused by current-induced shear stress and wave impacts.
- c. Corroded tie rods.
- d. Ballast protection at mudline.



Option C: Earth Anchor and Tube Waler



Option C: Anchor installation requires easement.



NOTE: As earth anchors are installed, grout is continuously pumped through the drill head, therefore no voids are created during installation.

Project	No. of Easements	Duration to Obtain Easements
Morning Canyon Erosion Control Project (2005)	18	9 months
Buck Gully Erosion Control Project (2011)	23	18 months
Balboa Islands Seawall Project	93	

Option C: Summary of Improvements

I. Balboa Island

- a. 640' of new seawalls at south West End
- b. 500' of seawall anchors/walers at north West End. (Easements required.)
- c. Raise cap on south side from 8.3' to 9.0'
- d. Raise cap on north side from 7.8' to 8.5'

2. Grand Canal (East and West Sides)

- a. Seawall anchors and walers. (Easements required.)
- b. No change in top of wall elevation.

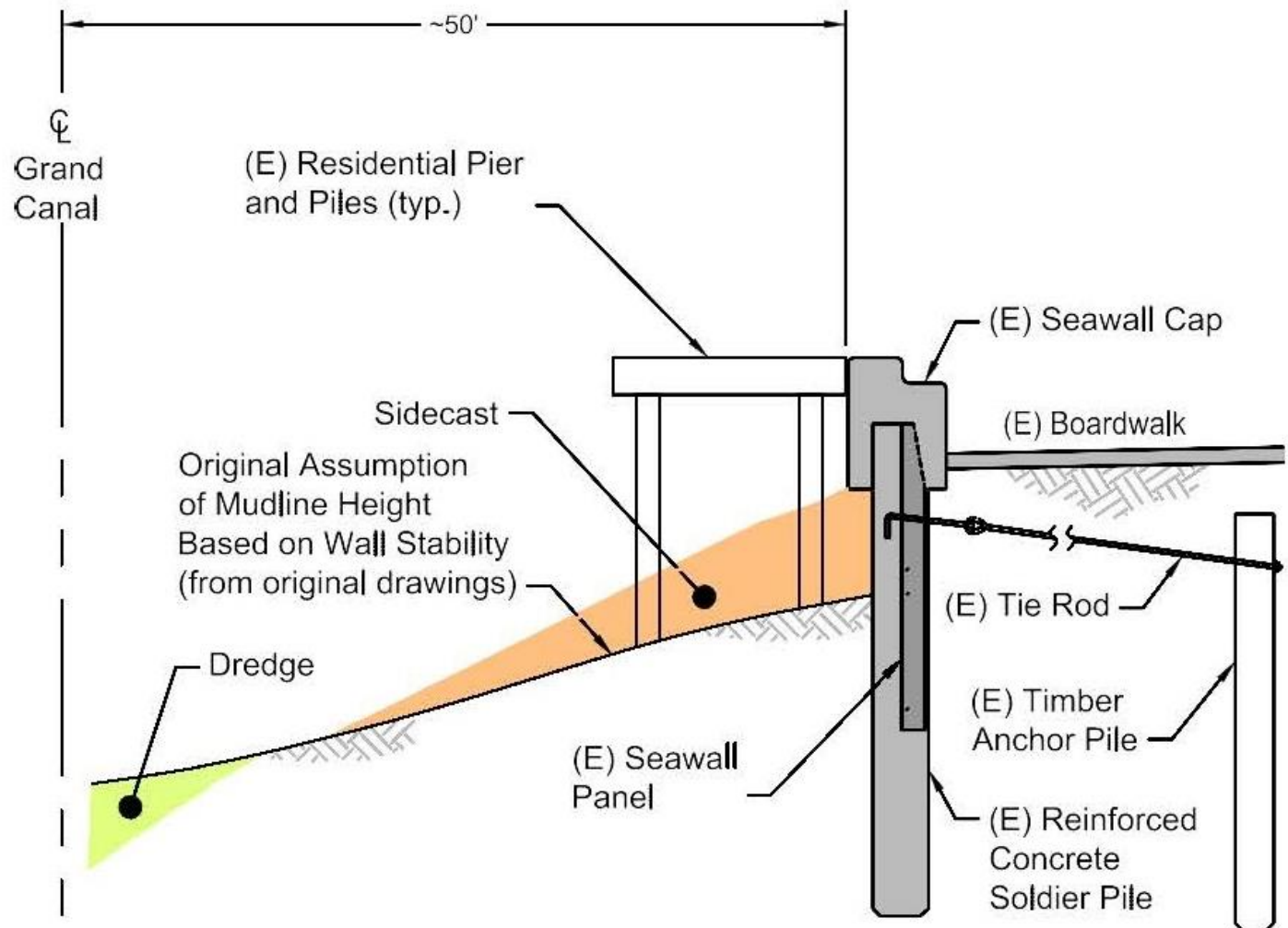
3. Maintenance Requirements

- a. Annual inspections. 10-20 expected useful lifetime of waler/anchor system.
- b. Repairs as needed.
- c. Annual sand buttressing to maintain mudline elevation.

Dredging for Sand Buttressing - 1999



Annual Dredging for Sand Buttressing



Option C: Cost Summary

Improvements	\$8.2 million
Enhanced maintenance (20 years)	5.0 million
25% Contingency	<u>3.3 million</u>
TOTAL	\$16.5 million

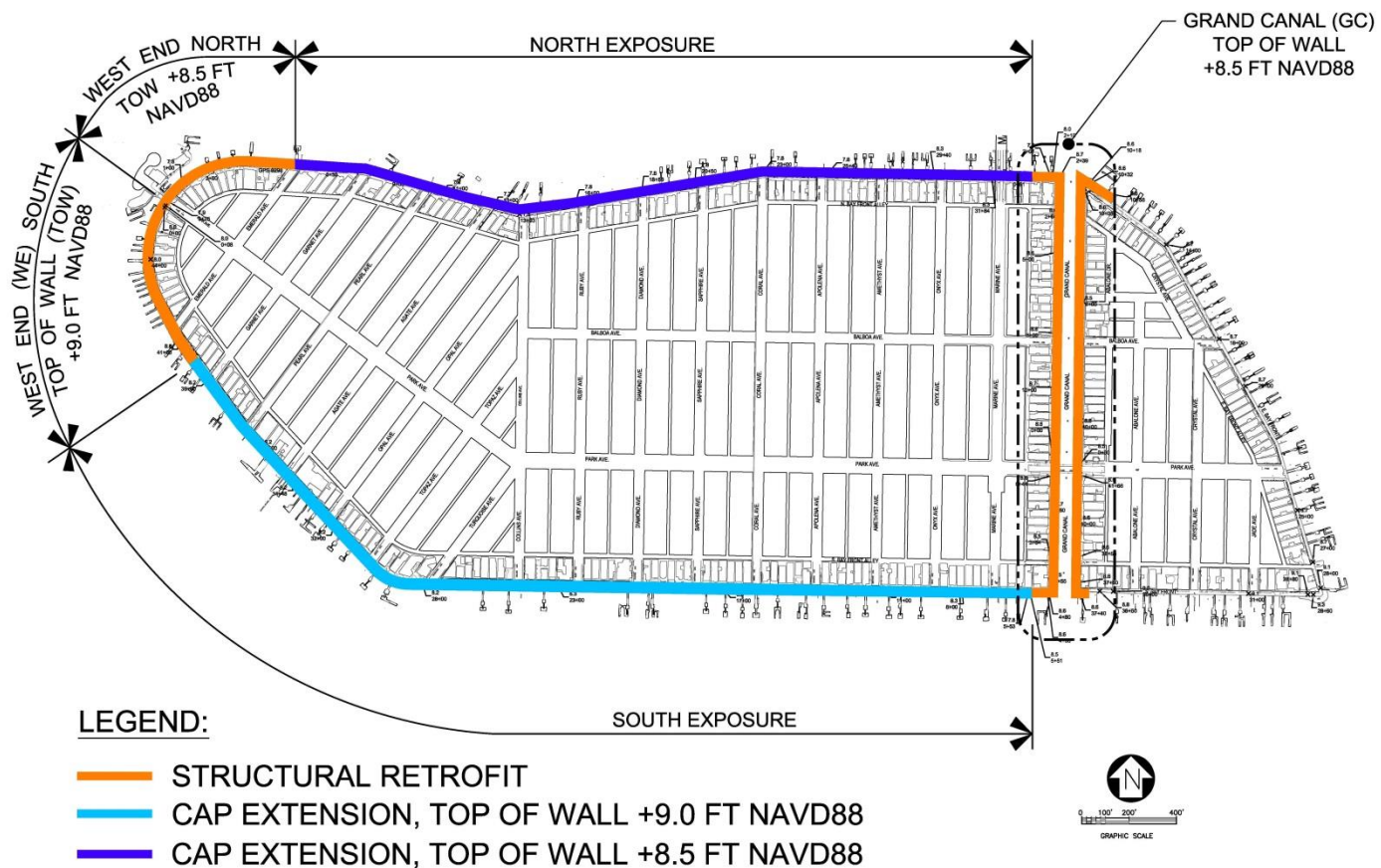
Notes:

1. Costs includes seawalls, caps, temporary pier and beach access ramps, modifications to the entrance to the Ferry Landing and Collins Islands, and ADA modifications to the Boardwalk near the Mariner's Bridge.
2. Cost to extend cap 6 inches in 2025 to Elevation 9.0'/9.5': ~ **\$6.5 million**
3. Cost to replace capped seawalls (in 2030-2040) when needed: **\$75+ million**
4. Costs in today's dollars.
5. Elevation Datum: NAVD88

Final Notes: Higher Risks Associated with Option C

1. Rehabilitation methodology is not protective per current seismic standards.
2. The shallow embedment of the walls in the Grand Canal put them at high risk of blow-out from seismically-induced liquefaction. No line item has been added in the estimate for emergency mobilization and repair.
3. Installation of anchors can damage existing walls. No line item has been added for a localized repair or replacement.
4. Over the next 25 years, future settling, cracking, plumbing leaks, etc. of houses could be claimed to be attributable to the seawall rehabilitation. No line item has been allocated for potential claims.

Option D: Seawall rehabilitation in Grand Canal and West End. Cap extensions for the remaining walls.



Option D: Cost Summary

Improvements	\$5.9 million
Enhanced maintenance (20 years)	5.0 million
25% contingency	<u>2.7 million</u>
TOTAL	\$13.6 million

Notes:

1. Wall integrity testing required as in Option C.
2. Costs includes seawalls, caps, temporary pier and beach access ramps, modifications to the entrance to the Ferry Landing and Collins Islands, and ADA modifications to the Boardwalk near the Mariner's Bridge.
3. Cost to extend cap 6 inches in 2025 to Elevation 9.0'/9.5': ~ **\$7.5 million**
4. Cost to replace capped seawalls in (2030-2040) when needed: **\$79+ million**
5. Costs in today's dollars.
6. Elevation Datum: NAVD88

Cost Summary (Immediate Costs)

OPTION	INITIAL COST	EXPECTED USEFUL LIFE
A. 10,352' new seawalls. 2,808' cap extensions.	\$68 million ¹	100 years
B. 4420' of new seawalls (Grand Canal and West End) + cap extensions	\$35 million ^{1,2}	100 years/25years
C. 640' of new seawall at south West End + Seawall rehab. of Grand Canal and north West End + cap extensions + enhanced maintenance	\$17 million ^{1,2}	100 years/10-20 years
D. Seawall rehabilitation of West End and Grand Canal + cap extensions + enhanced maintenance	\$14 million ^{1,2}	10-20 years

Notes:

1. Costs for cap extensions (2025, 2040) not included.
2. Costs for new wall construction (2030-2040) not included.

Comparison of Options B and C

	Option B	Option C
Initial cost (2020)	\$35 million	\$16.5 million
Easements required?	No	Yes. Delay of construction initiation significantly heightened.
Cap extensions (2025)	\$3 million	\$6.5 million
Replace capped walls with new seawalls (2040)	\$52 million	\$75+ million
Total Cost (present worth)	\$90 million	\$98 million
If rehabilitation works for 20 years		Obtained maximum <i>mileage</i> from seawalls.
If rehabilitation does not work		Investment in anchoring system wasted. Emergency repair costs. Property damage claims.
Risk of seismic failure	Low , but higher than Option A.	High
Overall risk of structural failure: 1 (low risk)-10	1-2	5-10

Preliminary Schedule

Task	Option B	Option C
Design, CEQA, Permits for Cap Extension	Sept 2015 – Sept 2016	Sept 2015 – Sept 2016
Cap Construction (~\$1 million + contingency)	April 2017 – Dec 2017	April 2017 – Dec 2017
Easement for Anchors		Sept 2015 – Dec 2016
Design, CEQA, Permits for New Seawall or Seawall Rehabilitation	Sept 2015 – Sept 2018	Jan 2017 – Jan 2020
New Seawall or Seawall Rehabilitation Construction	Oct 2018 – March 2020	April 2020 – April 2021

Present Value Cost Analysis

Phase - Years to Start	Option A	Option B	Option C	Option D
Phase I - 5 Years to Start	68,000,000	35,000,000	16,500,000	13,600,000
Phase II - 10 Years to Start	3,000,000	3,000,000	6,500,000	7,500,000
Phase III - 25 Years to Start	17,000,000	52,000,000	75,000,000	79,000,000
	88,000,000	90,000,000	98,000,000	100,100,000
Total Cost Over 25 yrs	139,893,224	128,871,428	146,139,949	150,570,196
Present Value Cost Est.	94,515,708	90,000,000	98,000,000	100,100,000

NOTES:

1. All options assume future costs to inflate by 3% per year.
2. All options assume a long-term investment earnings rate (discount rate) is also 3%.
3. Options A & B assume Phase I is cash funded with \$22.1 million with the balance financed.
4. Option A assumes a balance of \$56.7 million financed over 20 years at 4.50.
5. Option B assumes a balance of \$18.5 million financed over 10 Years at 3%.
6. Options C & D assumes Phase I is entirely cash funded.
7. All options assume Phase II & III is cash funded.

Funding History & Result

- Tidelands Master Plan – Prioritized Projects
- Harbor Capital Fund Created to fund Harbor Amenities on Tidelands Master Plan
- Source: Incremental Rents from:
 - Residential Docks
 - Commercial Marinas
 - Moorings
- \$15.8 Million Advanced for Dredging & Marina
- Dock and Mooring Rents Reduced
- Fewer funds available for Harbor Amenities

Harbor Capital Fund

Owes General Fund \$15.8 million

- Dredging \$9.7 Million
- Marina Park marina \$6.1 Million
- 15-Year Repayment Schedule thru 2030

After making annual repayment to General Fund, **Harbor Capital Fund** expected to net \$500K annually available for Harbor Amenities.

Funding Options

1. Consider Special Benefit Assessment
2. Convert Marine & Park Ave to paid parking –
Total \$2.1 million
3. Use Available Proceeds in Harbor Capital Fund
(may squeeze out harbor amenities)
4. Save \$3-5 million per year in addition to Paid
Parking:-Total \$20 million (may squeeze out
services)
5. Reduce Contributions to (FFP) Facilities
Replacement Plan (may obstruct projects)
6. Internal loan – From General Fund Contingency
(may increase exposure)
7. Finance balance, as necessary

QUESTIONS & COMMENTS



Public Works Department
A Well-Engineered Machine

*Protecting and Providing Quality
Public Improvements and Services*



Appendices

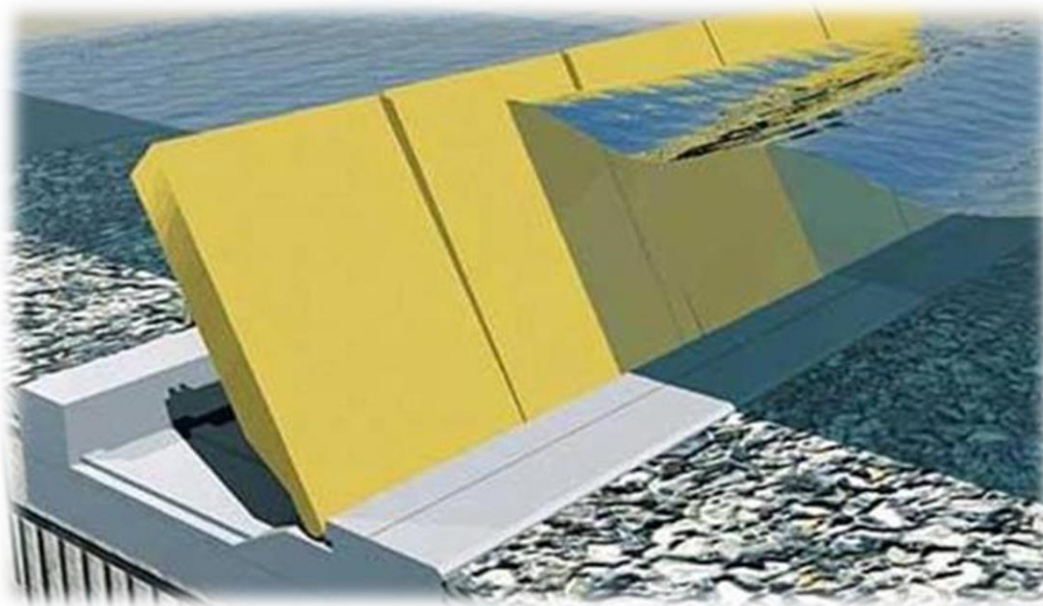
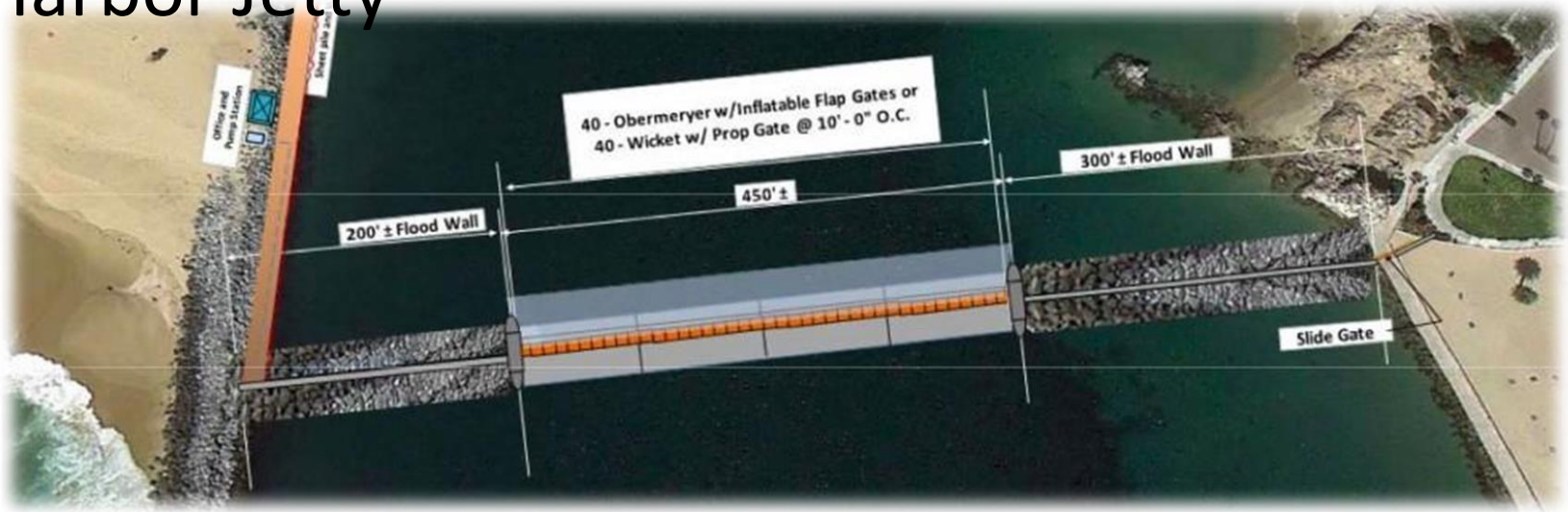
- 1) Ferry Landing Concepts
- 2) Tide Gate at Harbor Jetty Concept
- 3) Storm Dain Collection System Concepts
- 4) ADA and Beach Access Concepts
- 5) Public & Private Pier Connections Concepts
- 6) FEMA Flood Plain

Reviewed Potential for a Tide Gate at the Harbor Jetty: See City website for May 29, 2014 PowerPoint presentation.

<http://newportbeachca.gov/home>



Reviewed Potential for a Tide Gate at the Harbor Jetty



Summary on Harbor Tide Gate

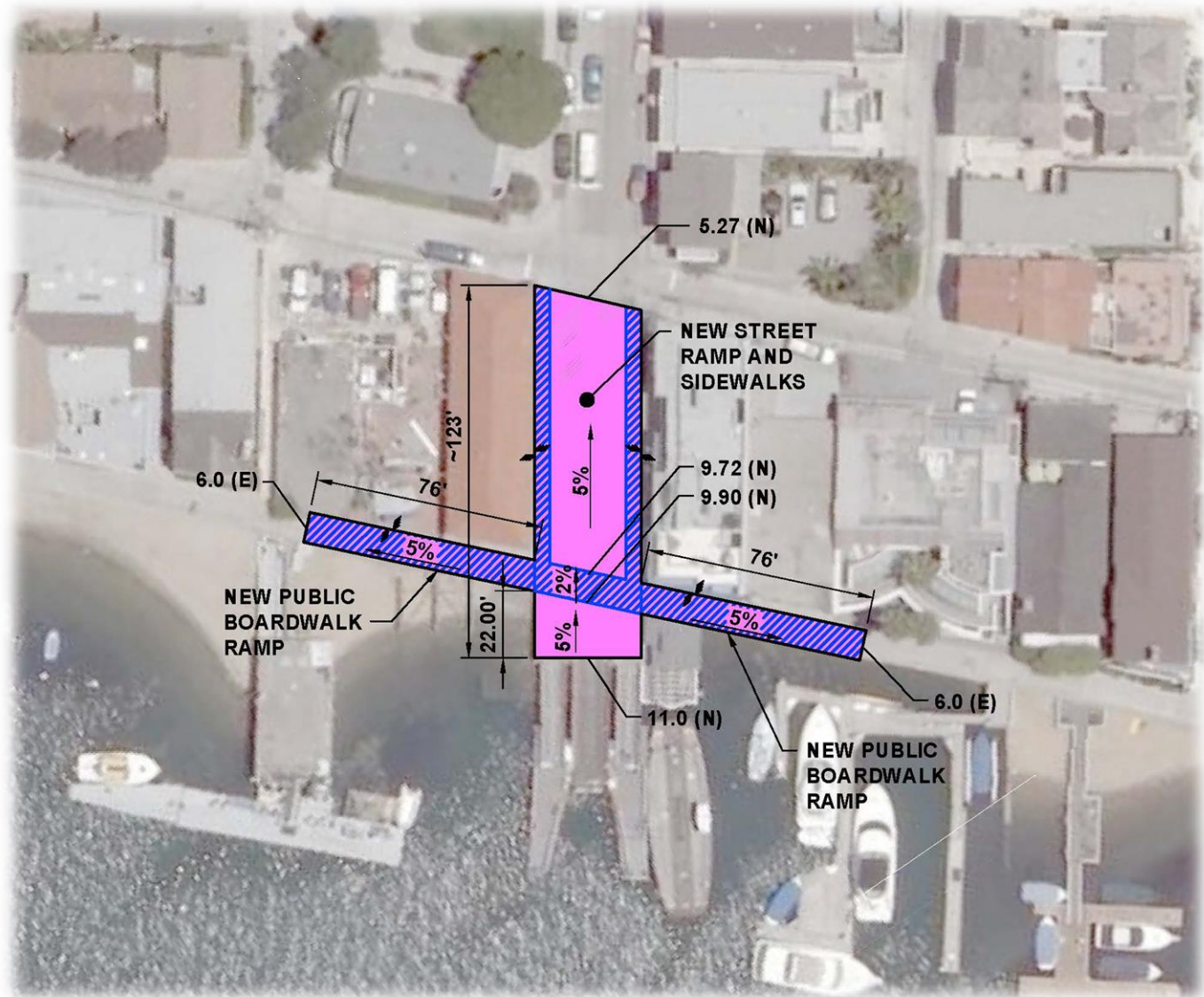
- Estimated installation cost of \$350 million or more.
- Design is dependent on the magnitude of sea level rise.
- Will have some level of operational effects on harbor entrance.
- Will not resolve structural concerns of the existing Balboa Island seawalls.
- Will not resolve water coming through and over the Peninsula.

Tide Gate at Harbor Jetty: Staff Recommendations Approved by Tidelands Management Committee:

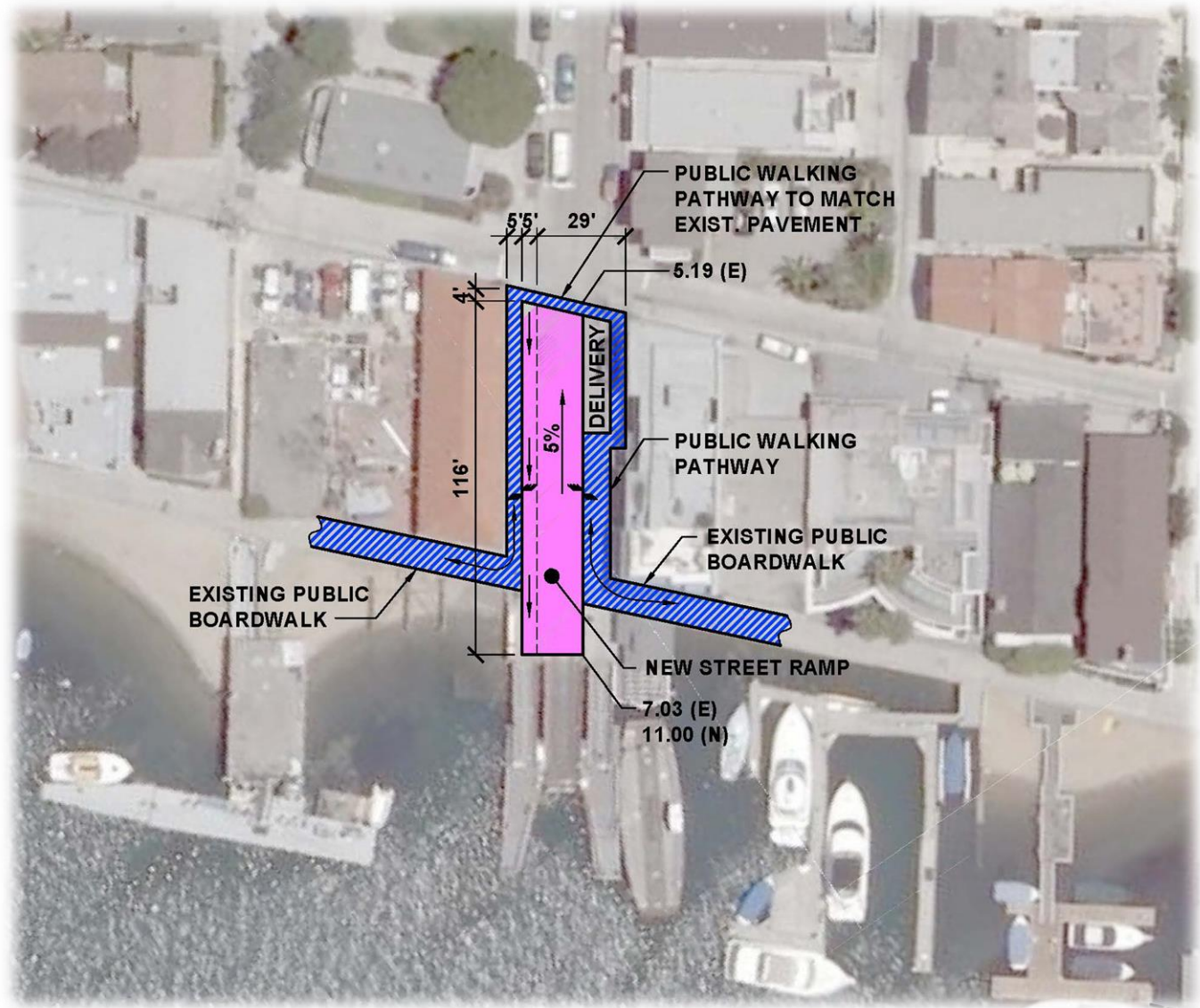
1. Verify sea level rise predictions
 - By about 2020, king tides could be 2-3 inches higher than today – on track for a 66” rise in sea level by 2100.
2. Set new harbor-wide standard for top of seawall elevation, e.g., 10 feet NAVD88
3. Set new requirements for finish floor elevations for new construction and/or major remodels.

Ferry Landing – Concept 1

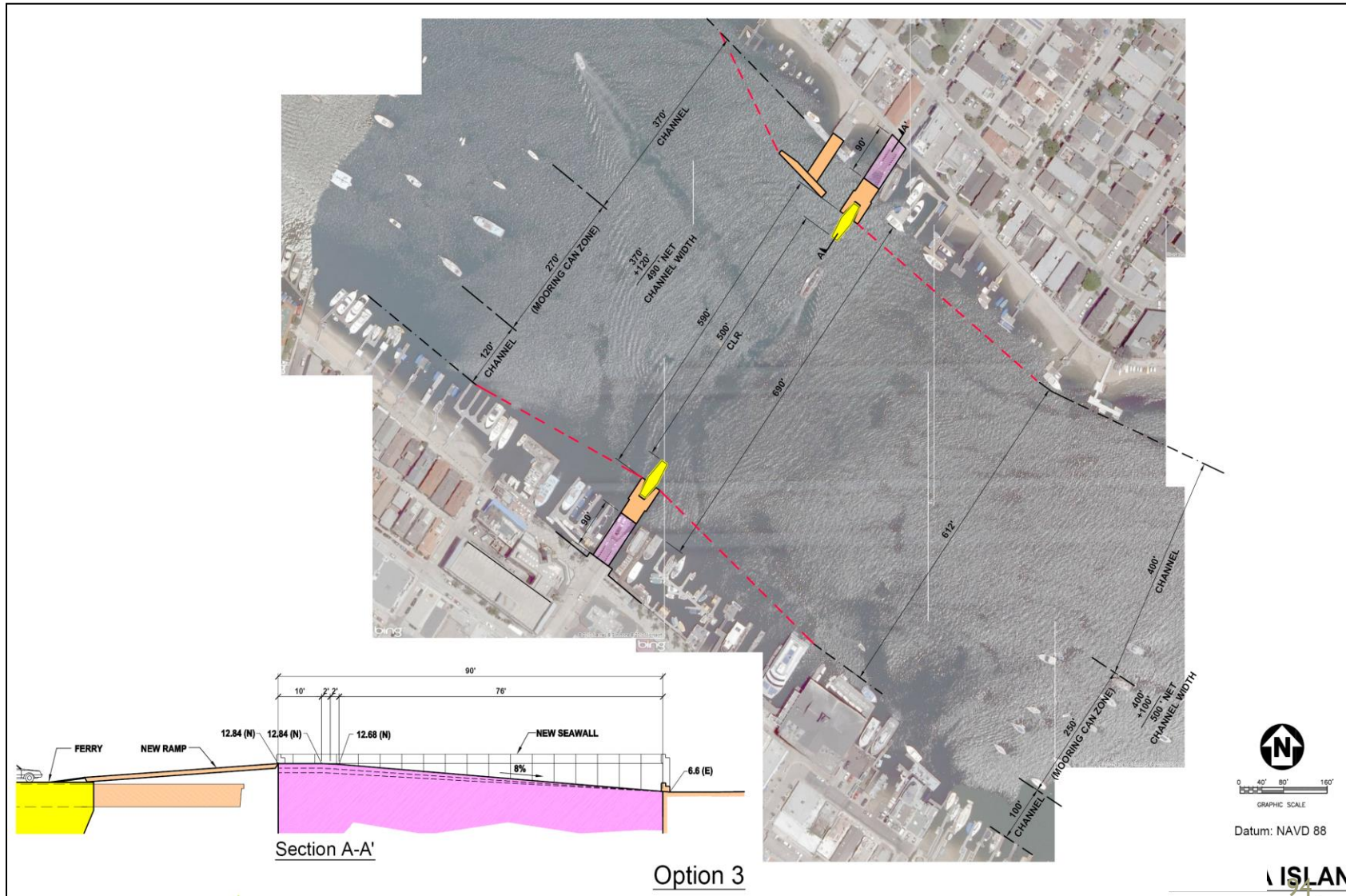
Boardwalk and Street Ramps



Ferry Landing – Concept 2: Diverted Walking Path



Balboa Island Ferry Modification - - Concept 3



Street End Flooding when Tide Gate Closed



Existing Drainage System on Balboa Island



Tide Valves

Protects the Island from Flooding due to High Tides
Currently Manually Operated

Manually Operated
with Valve Key

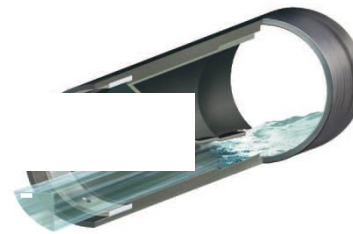
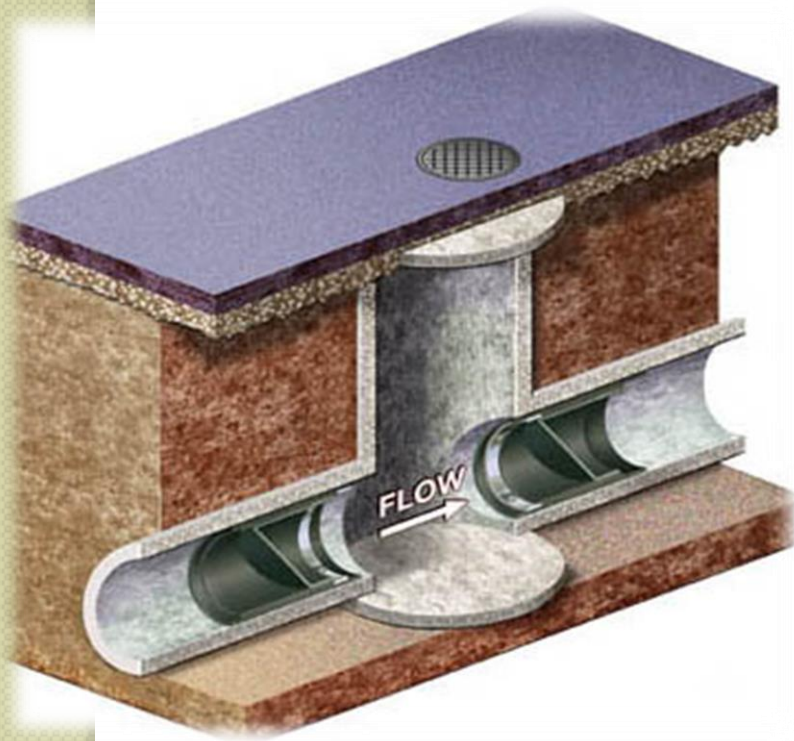


Power Assisted with
Manually Operated Up/Down Switch

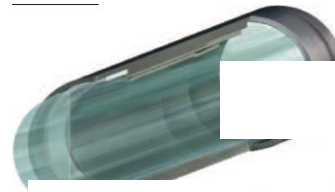


New Rubber Tide Valve (Check Valve)

- No Moving Mechanical Parts - Silent, Non-Slamming
- Non-Corrosive - Durable Rubber Construction
- Minimal Maintenance and Periodic Inspection Needed
- Around 1" of Water Pressure Opens Valve helping Eliminate Standing Water
- Simple Installation. Estimated 25-Year Life



Low Flow Open



Full Flow Open



Closed Against Tide

NEW DRAINAGE SYSTEM CONCEPT



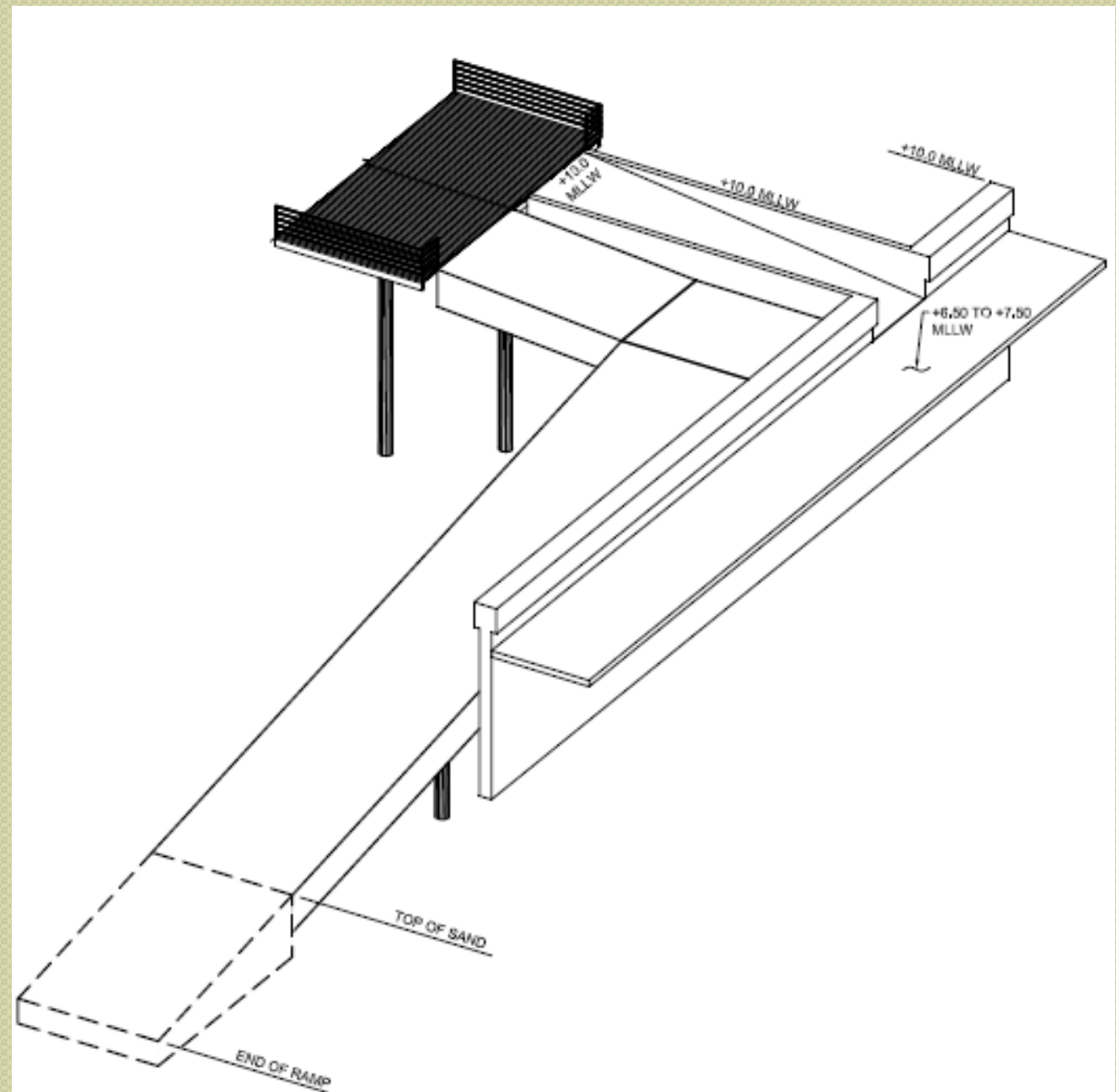
CONSOLIDATE GRAVITY DISCHARGE POINT WITH AUTO TIDE GATE AND PUMP STATION BACK UP



- Reduce Number of Discharge Points
- Automate Tide Values
- Provide High Water Pump-Out Capacity

Sub-Terrain
Storm Water
Pump Station

Public Pier and Beach Access

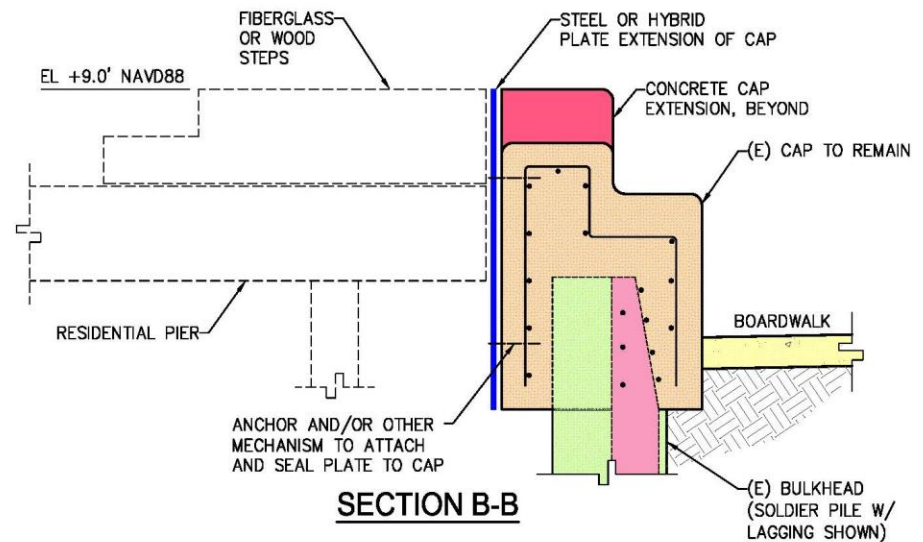
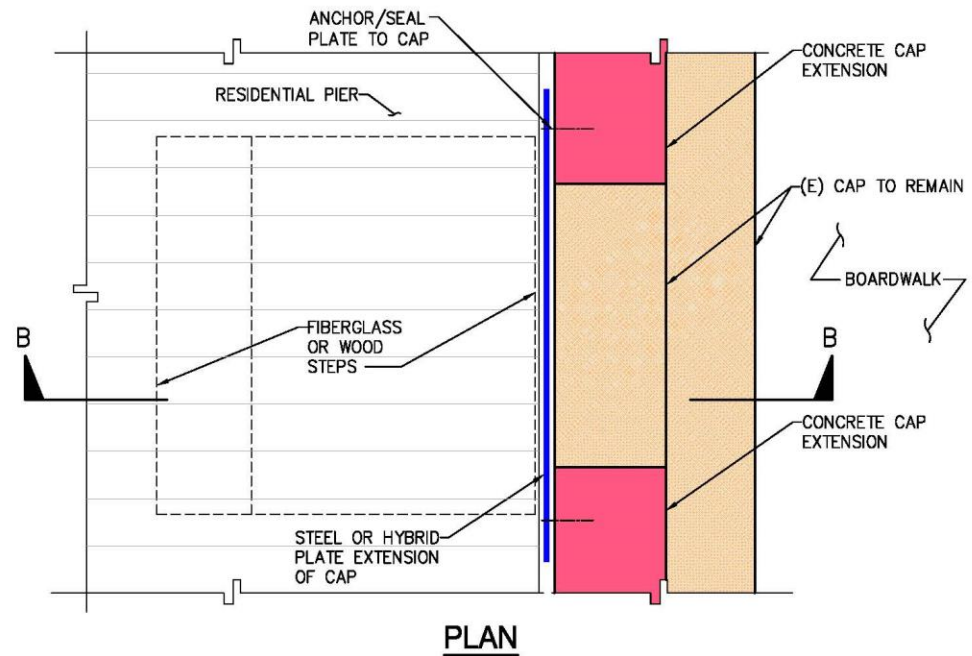


Balboa Islands and Floodplain Management Information

Please see the City's webpage:

<http://newportbeachca.gov/home/showdocument?id=15633>

Proposed Steps Over Extended Cap

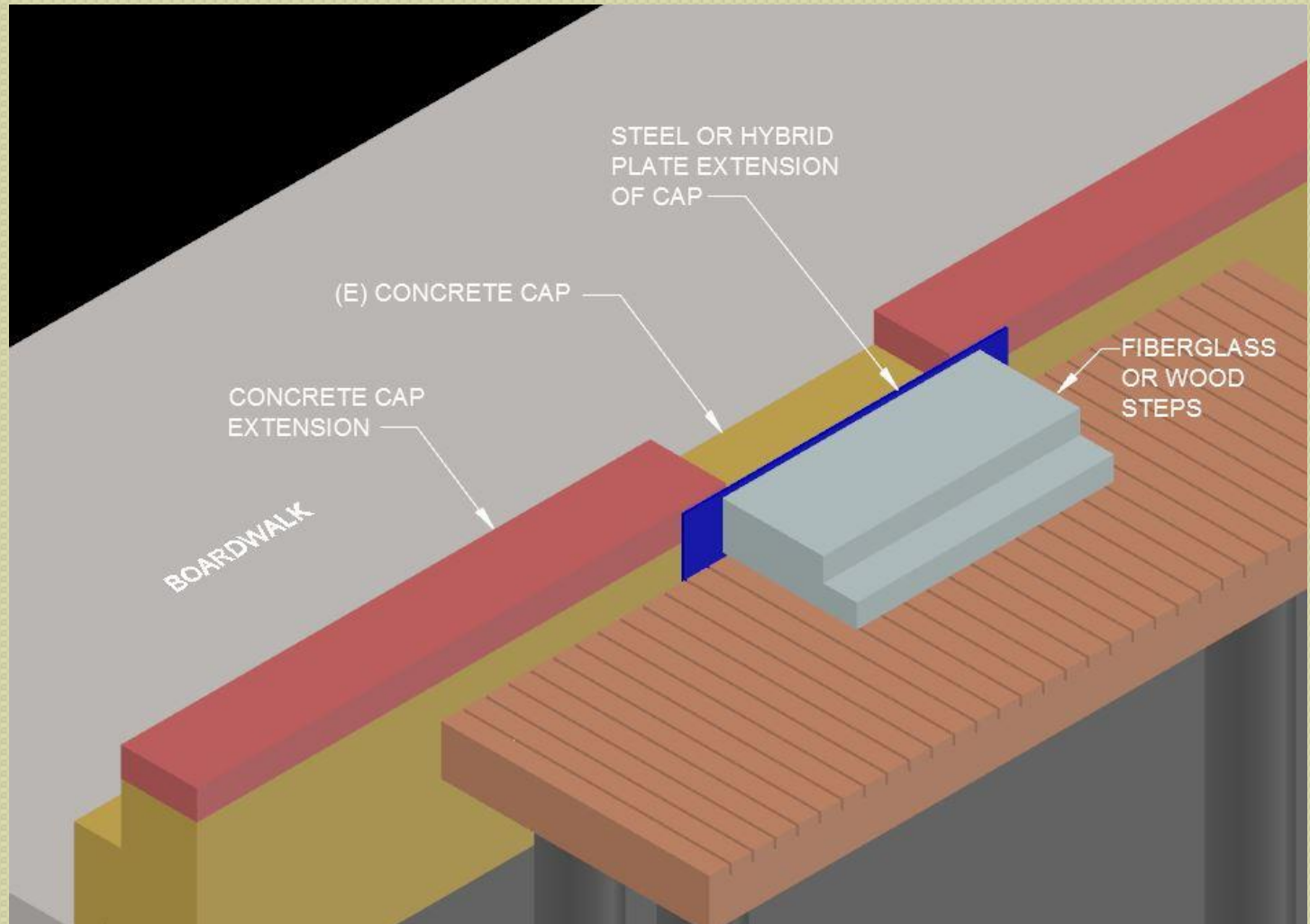


DETAIL A - CONCEPT
(Steps Over Cap Extensions)

Beach Access Concept



Private pier access



Option C: Enhanced Testing Program Cost

- Cost for core samples, lab tests, report, and presentation at Grand Canal & West End Only:
 - Sampling at approx. 200 foot intervals
 - Samples at various heights (e.g., low, mid and top)
 - \$150,000 to \$200,000

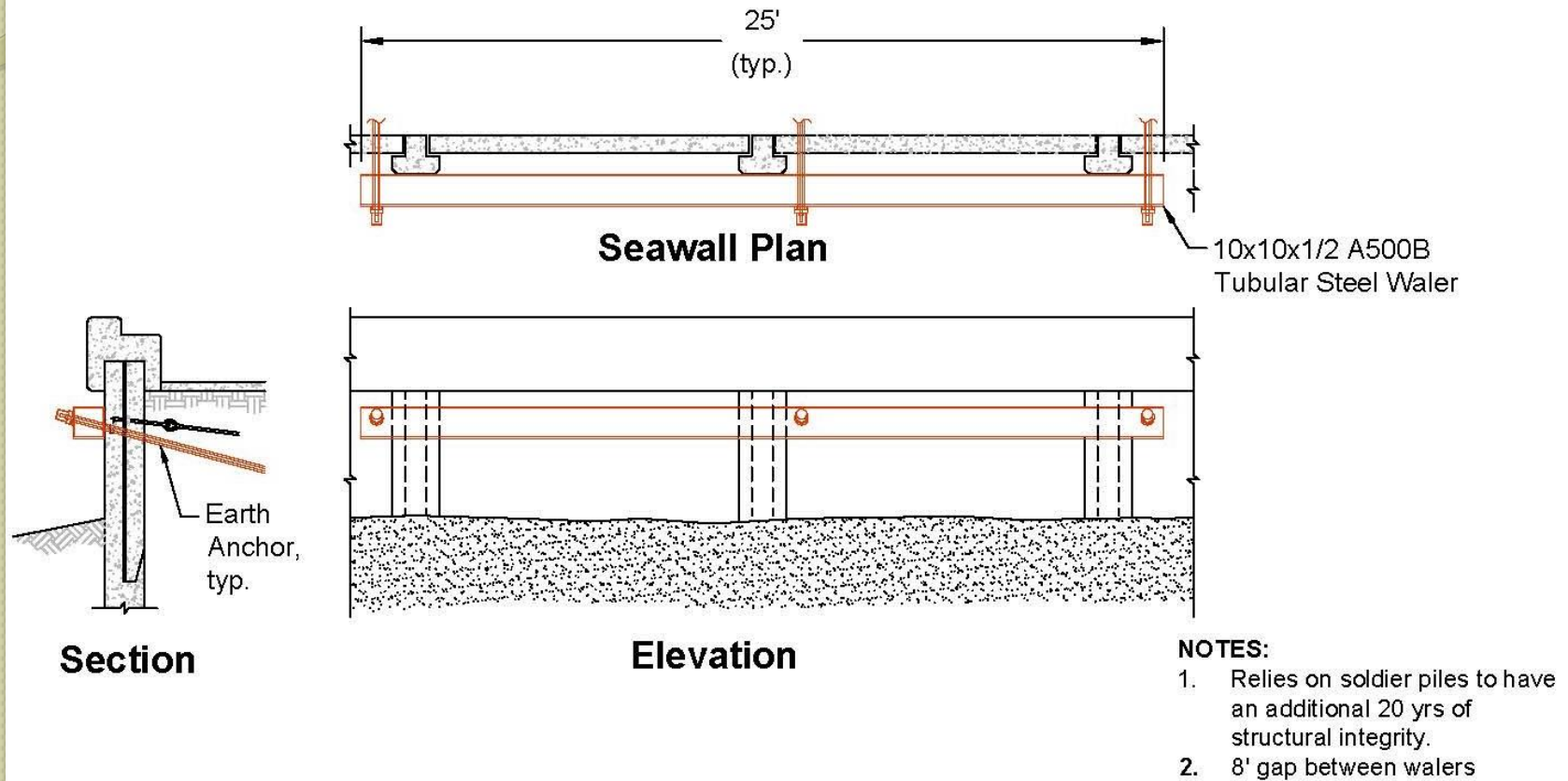
Option C: Enhanced Testing Program

- Coring Samples
 - 2" – 3" diameter samples – full penetration
 - 3 cores per panel at 200' intervals
 - 3 cores per soldier pile at 200' intervals
 - Thin part of soldier piles only 8" – 10" wide
 - 65 core samples for Grand Canal & West End
 - 200 core samples for entire island
 - Concerns: Core samples/reinforcing adjacency, un-sampled areas.

Waler (Beam) and Anchors



Waler and Anchors



Waler Option 1

Sea Level Rise

